COMPUTER ORIENTED APPROACH FOR STATISTICAL ANALYSIS OF HINDI TEXT CHARACTERS AND SPEECH SYNTHESIS

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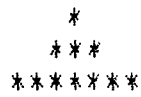
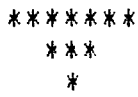


Dedicated to my parents

&

Loving Sister



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Chapter 1

G E N E R A L I N T R O D U C T I O N

INTRODUCTION

One of the most basic human capabilities is the act of expressing the thoughts generated in the minds of human beings. To communicate ideas and thoughts, the primary and the best way of communication is SPEECH.

The thoughts are generated in the forms of neural signals in the mind of human beings, who translate these signals into longitudinal vibrations (acoustic waves) through their unique possession, the vocal apparatus. These signals are detected by the ears of the listener and are invested to the brain for understanding. That is the simple mechanism of the exchange of ideas and thoughts.

Speech as a mode and means of communication is far ahead of even the advanced high technology media communication developed todate. The need of speech as means of communication can best be appreciated by those who can not speak at all and by those who have problem in the communication with others.

To extend the man's capabilities and to increase the productivity of human beings, utilization of speech for communication between man and machine has been a significant requisite and the main motivation factor for developing speech interactive systems. The basic mechanism of speech communication with machine is to functionally duplicate the behaviour of human communication link , i.e, the mechanism of speaking and that of understanding.

In order to communicate with machine the mechanisms of speech production and that of speech perception - comprehension are done by means of three main activities.

1. Speech Recognition : Understanding of spoken words.
2. Speech Synthesis : Text to speech conversion
3. Speaker Identification /verification : other advantages

The aim of the above activities is to develop a machine which can recognize the speaker, understand his message and give a suitable reply in voice mode by means of synthesized speech.

For the development of above type of systems, Speech recognition and speech synthesis are the two main steps which also make Man-Machine communication easy. In order to achieve success in speech recognition and synthesis, it is necessary to understand the nature of human speech production and analysis of the speech wave.

As far as speech recognition is concerned all the speech recognition systems could be classified into two categories.

(i) Isolated Word Recognition System (IWRS).

(ii) Continuous Speech understanding system.

The vowel recognition and digit recognition ,which falls under category (i),have been made in 1950's. In the last 5 years, many Isolated word recognition system with small vocabulary have been commercialised. Attempted are being made these systems for larger vocabulary and reliable at resonable cost. For speech understanding systems,however the research is still in the preliminary stages and a concerted effort is desired. These

systems should comprehend the meaning associated with the speech signal even if they are not able to correctly recognize the phonemes or words present in the signal. Excellent overview about the advancement of entire speech recognition field, speech understanding and Isolted word recognition system has been given by Reddy(1),Martin(2), and Schroeder(3).

Moreover, synthesized voice as output of computers is an advance step of Man-Machine communication. On the basis of the relations and characteristics of speech, the models of speech production can be simulated on a computer. Such systems have been initially implemented at Bell Laboratory and are being developed in some laboratories in India too.

The researchers are giving more emphasis on automatic speech recognition system for continuous speech understanding. So far machine is unable to segment a complex speech signal and unable to understand the uttered speech into a isolated word from a continuous speech. As a result the accuracy of the speech recognition becomes poor. Second major problem is due to large vocabulary of the system by which the speech matching becomes much expensive. Thereby rendering the efficiency of the system becomes poor.

Besides, a lot of other genuine problems are making the task of speech recognition difficult ,e.g., language of communi-cation, Knowledge of syntax, speaker and environment of message.

The non-availablity of contextual informations is the one of the main reasons of these problems. To solve these problems ,it is necessary to find out the basic reason. When a man

recognizes normal speech, we discover that a high degree of intelligence is involved because of the need to use contextual informations. It is obvious that speech has many complex sounds, to analyze these sounds the use of contextual information is essential. If we supply contextual informations about the sounds the man would be able to recognize it quickly.It follows therefore that for recognition higher sources of knowledge are needed. The various type of knowledge sources which are required to operate at various levels could be listed as

i. The characteristics of speech sounds.
ii. Variability in pronounciation
iii. Stress patterns
iv. Sound patterns of words and dictionary (Lexicon)
v. Grammatical structure of language
vi. Meaning of words and sentences
vii. Context of conversation

It is obvious that only after introducing these sources of knowledge we will be able to recognize more correctly the phonemes syllables and words of the language in continuous speech.

Chapter 2

Statistical Analysis of Hindi Text Characters

AIM OF THE STUDY

The automatic speech recognition using only acoustic cues have not been successful so far. The reason is that the acoustic charactersitics of phoneme varies with the preceding and the following sounds. The speaker produces sounds whose acoustic characterstics depends upon a variety of factors ,viz., individual articulatory charactersitics which depend upon several different features, phonetic environments of the sound produced, dialectal variation etc.

A listener makes a rough estimate of the phoneme being received and keeps on correcting the complexities by making use of the higher sources of knowledge of the language. A machine may therefore, be expected to take account the same sources of knowledge during the process of recognition.

Such type of systems which are dependent on language would require knowledge of the statistical information , syntax,grammar etc. of the language. The statistical studies of Hindi have been usually done manually and have poor statistics . The present study attempts at enriching the statistics by dealing with a large volume of data derived from different representative sources and extracting more meaningful and varied information by using computers.

REVIEW

Statistical information about different languages of the world is being updated continuously. Whitney W.D.(4) in proportional Elements of English Utterence " proceedings of the American Philological Association (July 1874) tabulated the frequency of occurrence of 10,000 sounds taken from 10 samples (5 poetry and 5 prose) from ten different periods.

The word count was given by R.C.Eldridge(5) in ' six thousand common English words' (Niagara Falls 1911) to determine whether or not it would be suitable for use as the basis for some investigations . Eldridge has a method of entry ,e.g.,like act,acts,acting. This study also presented the frequency of each word.

Edward Thorndike(6) published the work for word counting in "The Teachers word Book, New york 1921" and 'A Teachers word book of the 20,000 words' which were found most frequently and widely in general reading for children and young people (1944). He extended their study as a co-author for ' A semantic Count of English Words' (New York teachers Coulumbia University,1938).

Godfrey Dewey(7), in the relative frequency of English speech sounds: Cambridge Masssachusetts (1923) made a study of the frequency of occurrence of the sounds syllables found in 100,000 words taken from news paper, modern fiction, modern

American's speeches, personnal and bussiness correspondence, modern and advertising religious works, scientific publication and magazines. He transcribed these words according to the pronounciation given for them in "The standard dictionary " (Funk and Wagnalls).

Ernest Horn(8)Professor of Education at the university of Iowa was interested in spelling rather than in reading vocabulary. He collected material by himself for in reading vocabulary for several years and also included material of previous studies for his work . His result was based on a count of 5,136,816 running words.

'Interim Report on Vocabulary selection(9) published by the institute for Research in English Teaching (Tokyo 1930)' gave emphasis on important words count

The frequency of occurrence of speech sounds in a list of 80,000 words obtained from telephone conversation was determined by N.R.French,C.W.Carter and Walter Koeing Jr(10) in a monagraph of Bell Telephone System technical publications, (1930). The pronounciation of these 80,000 words had as its standard the pronounciation of the educated person in New York. Variant pronounciation of about forty common words was recorded. However the / a/ and /an/ were omitted from the analysis on account of their variants.

L.E.Travis, (11) Phonetically recorded the frequency of occurrence of speech sounds in conversations with university adults, labourers and children in 1931. He included only the data for the consonants in his tabulation and gave almost no details

concerning procedural matters in the study.

To study the oral vocabulary of adults Black and Aushernam(12) presented a 'Teacher's words book of the twenty thousand words', New York(1932). They collected speech materials for samples from worker's speech which consist of 3000 workers (men and women) in 1500 different days.

A count of 660,594 sounds of 5946 radio announcements was made by Charls H.Voelker(13), ("Techniques for a phonetic frequency distribution count in formal American Speech", archives Neerladaises de Phonetique Experimental ,1935). Phonographic recordings were made of the radio anouncements and were later transcribed phonetically by teams of "Observers" . Voelker felt that the announcers might be "considered as approaching the norm for typical American pronounciation. He states further more that "they had no suspicion that their voices were being recorded and so would not be tempted to alter their ordinary pronounciation.

The frequencies of the phoneme in general American English were determined by Rebecca E Hyden (14)("The realative frequencies phoneme in general-American English" ,Word VI, 1950)) Mrs Hayden's study was based on 65,122 phoneme taken from lectures by 6 members of the university of California administration and faculty. Her study is the first analysis of the phonemes of American English to be made with a quantitative statistical approach.

The frequency of occuerrence of 20,028 phonemes in an idolect of a general Eastern U.S. variety were tabulated by John B. Carroll(15), ("Transitional probablities of English phonemes "

March 1952). The phonenticizer, Frederick Agard, transcribed his own spoken version of selection read from eleven different plays. The system of phonemic notation used was that of Trager and Smith. Two degree of stress and the presence of junction of any of the four types were recorded.

John W. Black and Marian Aushrenam's study(16) has a formed speaking vocabulary of young men of college age which specify the over all vocabulary of a group of 274 students in 607 class room speeches.

F.J.Schonell I.G. Meddlelton, B.A. Shaw(17), et al. showed a study of the oral vocabulary of adults (Brisbane University of Queensland Press 1956) .

Four samples from modern English prose were transcribed phonetically by Murray Fowler(18) in " Herdan's statistical parameters and the frequrncy of English phonemes" in 1957). The frequencies of occurrence of the phonemes in group of 1000 were tabulated for three of the samples. All four samples contained 15,445 phonemes.

Certain amount of information about language statistics is of course, available in the literature given by Wang and Crowford (19) in 1960. Mostly these surveys consists the phoneme and words frequencies counts, although very limited information about phoneme DIGRAM is given in some of them.

Denes P.B.(20) from Bell Telephone laboratory in 1963 obtained a variety of statistical information for spoken English. The data were the results of analysis a considerable

body of conversational material and narratives from "phonetic readers ". The material collected is of spoken English language and not a written script. Denes consideration is basically for three different statistics, i.e, the frequency distributions of (i) Phonemes , (ii) Phoneme DIGRAMS and (iii) Minimal pairs and (iv) about the word length. 'Stress' was taken into consideration and statistical information was obtained separately for the stressed and unstressed syllables. The text for such study consisted of 72210 phonemes forming 29916 syllables and 23052 words. All results were evaluated from the articulatory point of view and analyses were carried out by using a digital computer.

Reddy D.R and Neelay R.B.(21) made some efforts in this regard in 1968. The study presents some needed contextual and probabilistics data about TRIGRAM phonemes sequences of spoken English. The main goal of Reddy's study is to provide data about frequently occurring neighbours for each phoneme in English. They stressed that there will only be a few distinctly different acoustic manifestations of each phoneme and that the sound intended can be determined in the context of the neighbouring sounds. To study such 403 TRIGRAM sequences 3 types of tables have been given.

(a) Commonly occurring TRIGRAM sequences of the form /∝β∀/ for every phoneme /β/.

(b) Commonly occurring sequences for even pairs of phoneme /∝/ and /∀/.

(c) Commonly occurring word boundary sequences of the form/ ⁻∝β/ for even pairs of phoneme /∝β⁻/ where /⁻/ represent the silence phoneme.

The material selected in Reddy and Neeley's study for the analysis was from "A spoken word count " by Jones and Wepman (27)(1966) out of a total number of 136,450 words by 54 speakers they give a list of about 3,100 words that were used by two speaker. The data were analysed on a PDP-10 computer with a 128k memory.

One easily word counter , Rev. J.knowles, the London (1904) points system of reading for the blind . He counted 100,000 words felt fit to publish only the 353 most common words.

Moreover works on Swedish language Olof Werling Melin's(22) two word counts published in stenographiens historia, 2 (1921). They cover 10000 running words and give for instance, the frequencies of 100 most common words.

Teachers word book of 30,000 words (1944) by Edwand L. Thorndike and Irving Lorgl(23) regarding word frequency investigation for Swedish language was followed by the two recent works : Frequency dictionary of Spanish words (1964) by Alphones Juilland and E. change Rodriquez and computational analysis of present day American English (1967) by Henery kucera and W Nelson Francis.

Besides these study some information on frequencies in spoken and written Swedish is also given in a paper by Gunnar Fant(24) (1967). His investigation covers a 22000 running words from news papers articles and 63000 running words from telephone conversation .

Some attempts also taken by Sweska, Dagbladet, Stockholms-Tidningen, Dagens Nyhets, Goteborgs hardels-Ochsjofants-tiding and Sydsvenska, Dagbladdet sullposta for Swedish lanuage. In 1965 during five periods of fourteen days. They collected the texts from telegrams, from news agencies,advertisements,letters, from readers, anonymous contributions, sport articles by non swidish author.

P.G.Widegren (25) covers a material of 530000 running words taken from the permanently records and Text .

Tripathi J.N.(26) in his study(1971) presented the probability of occurrence of Hindi text characters. He showed that Hindi is less redundant than English on the basis of his analysis. Moreover, he found that computation of probabilties of occurrance of Hindi character is more complicated than English due to presence of half letters and matras. He omitted some symbol of Devanagri to make it a telegraphic language . He was of the opinion that the symbols which were with small frequency of occurrance may not be included for the language. He suggested that 7 vowels, 9 matras and 27 consonants are sufficient for frequent transmission of Devanagri. For his work, he took study material consisting 10000 phonemes collected from different sources like weekly magazines .

SPEECH MATERIAL (DATA)

It is desirable to take samples of spoken language of

native speakers for the statistical studies of language . However records of radio announcer, telephone conversation and printed texts, etc. had been used by authors due to lots of difficulties in recording spoken samples.

One of the problem with spoken language is that there will be perceptual errors in phonetic transcription and listener will try to write what is expected rather than what is spoken. Although Hindi language has no silent consonents and written exactly as spoken and there is no need of pronouncing dictionary as required for English and other languages.

In some studies telephone conversation is taken as a representative of spoken language (French (11) etc.). In Indian context telephone conversation does not make a common language for several reason. Firstly telephones are owned by affluent class only. Secondly most of the people are multilingual so they frequently use words from English, Punjabi,Urdu etc in their conversation. Thirdly there are legal problems to record the telephone conversations as the right of privacy of conversations can not be violated.

In studies of French,Carter and Coeinig,Fry Walker( ), Wang and Crowford ( ),W.D.Whitney (4) for American English, Edward(6),Hasslen-Goransson for Swidish language, J.N.Tripathi (26) for Hindi have considered the written material as a corpus of statistical studies.

The following criteria are suggested by A.Hood Roberts for a statistical lingustics analysis of American English.

1. Actual frequency of occurrence of all words should be shown in

list.

2. The word count should be on a larg number of running words.

3. Samples should be based upon every day English.

4. The word count should be based on samples of living English and not of historical litrature.

5. The word should be the unit of entry rather than proper names other than the names of the months and days should not be entered in the tabulation.

6.The word count should record abbriviation also.

We made choice of printed materials as the corpus of the statistical study. To make our corpus near to spoken everyday Hindi, our corpus contains materials from local, regional and national daily news papers and their letters to editor column, childrens book, social & film stories and other popular magazine articles, comics etc. The material was collected randomly from different pages of the above litrature. The data of different dates of a few lines from all column of randomly selected news paper's page were taken as to cover a wider range of subjects. As the news paper's language is an edited one it may have bias of the Editor. Hence Beside taking different news of local, regional and national level newspapers we also included letter to editor column of newspapers . Of course, letter to editor column is also edited in some manner but it largely contains words used by people. As films are very popular with masses in India we have taken material from film magazine which also included samples of transcripts of film story .Some collection from comics and children's books are taken because it uses vocabulary of children and is also read by them. Some

studies were performed by using materials of official correspondence. One can also include private letters for corpus to make it general but it is difficult to do the same in a smooth way.

The final form of our corpus contains 51000 phoneme forming 12000 words from different sources which is much more than Tripathi's number of phoneme 10000 .The sources of samples are given in Appendix- A.

CODING CRITERIA

Devanagri computer terminals have been in the market of late. We have, however, used the general (English) computer keyboard because we do not have one and mainly because we want to use the algorithim developed for Hindi for other Indian languages too.It is required to develop a code (special notation) to input phonetic symbols of Hindi into the computer. We used a code proposed by Vijay Krishna et. al. (31)for presenting Hindi characters to a computer (see Table i & ii). The criteria for selecting this code were the ease of coding and decoding. It is a variable length code of one to three keyboard characters. A further criterion was to keep the code as close as possible to the Roman orthographic rules. The short vowel-matras were repesented by A,I,U,O_ _ _ etc. Their long vowel matras were formed by adding an astersik as a suffix ,e.g.,A*,I*,_ _ _ _ etc. The vowel as letters in Hindi text were derived by putting prefix 'F' to corresponding vowel matras 'FA', 'FA*', _ _ _etc. For the aspiration of stops we used an asterisk instead of using

Codes For Vowel LETTERS and MATRAS

LETTER	CODE	MATRA	CODE
अ	FA	-	A
आ	FA*	ा	A*
इ	FI	ि	I
ई	FI*	ी	I*
उ	FU	ु	U
ऊ	FU*	ू	U*
ए	FE	े	E
ऐ	FE*	ै	E*
ओ	FO	ो	O
औ	FO*	ौ	O*
अं	FN*	ं	V*
अः	F:	ः	:
		ँ	M*

Table - I

Codes for Consonants and Others

LETTER	CODE	LETTER	CODE	LETTER	CODE
क	K	ख	K*	०	0
ग	G	घ	G*	१	1
च	C	छ	C*	२	2
ज	J	झ	J*	३	3
ट	X	ठ	X*	४	4
ड	W	ढ	W*	५	5
त	T	थ	T*	६	6
द	D	ध	D*	७	7
प	P	फ	P*	८	8
ब	B	भ	B*	९	9
म	M			।	.
न	N	ण	N*	.	.
य	Y		Y*	,	,
र	R	ड़	R*	;	;
ल	L	ढ़	L*	-	-
व	V			/	/
स	S	श	S*	(	(
ह	H	ऋ	H*	)	)
ष	Q	क्ष	Q*		
त्र	Z	ज्ञ	Z*		
ङ.	:*				

Table - II

गजराज हाथी अपने एकलौते
GAJARA*J HA*T*I* FAPANE FEKALO*TE

बेटे राजू को बहुत प्यार करता था ।
BEXE RA*JU* KO BAHUT PYA*R KARATA* T*A*

पालिका घोषित किए जाने के
PA*LIKA* G*OQIT KIFE JA*NE KE

पश्चात भी नगरीय समस्याओं के
PAS*CA*T B*I* NAGARI*Y SAMASYA*FO KE

प्रति उपेक्षा
PRATI FUPEZ*A*

लड़कियों के फाइनल में मोता
LAR*AKIYO KE P*A*FINAL MEV* MI*TA*

सिन्हा ने ज्योति मेहता को चार गेमों
SINHA* NE JYOTI MEHATA* KO CA*R GEMOV*

ILLUSTRATION OF CODING

Table - III

character H as in usual Roman transcription. The half Consonants were not alloted separate symbols. Instead they were represented as full consonants and their status could, however, be deduced during the processing of the coded data. Some of the frequently occurring compound sounds were given separate symbols for simplicity in coding.

No efforts have been made to have this Romanization code for purpose of converting it to Hindi script. An illustration of the coding is given in Table III.

COMPUTATION OF PHONEME FREQUENCIES

Our work to get a statistics of frequency counts of phonemes by computer processing of the coded text is the part of the goal. After coding the whole corpus, the coded data was stored in a file with 80 bytes for each record.

A computer program for frequency counts of characters, has been made. The flow diagram of the computer program is shown in Fig. 1.

Program (see Appendix-B) description is like this that the character '$' in column 1 of the record indicated a comment record. These records were not processed. The end of data file marked by character '&' in column 1. The data file was read one record at a time. The code, was segmented into four valid lists. the first valid list had characters of the type F##, where # was any allowed alphabetic character. The second list was of the type F#,. The third list had single characters ##, The occurrence is determined through comparison with valid characters. If the

characters was not from a valid list of characters it was an error. The error was marked by printing character '+' directly under valid code character on the outform, record after the record; for example, if we write FF* instead of F* in our data, we get a positive sign over the FF*. It means the data is not from a valid list. The samples of the work is given in Appendix C.

RESULTS AND DISCUSSION

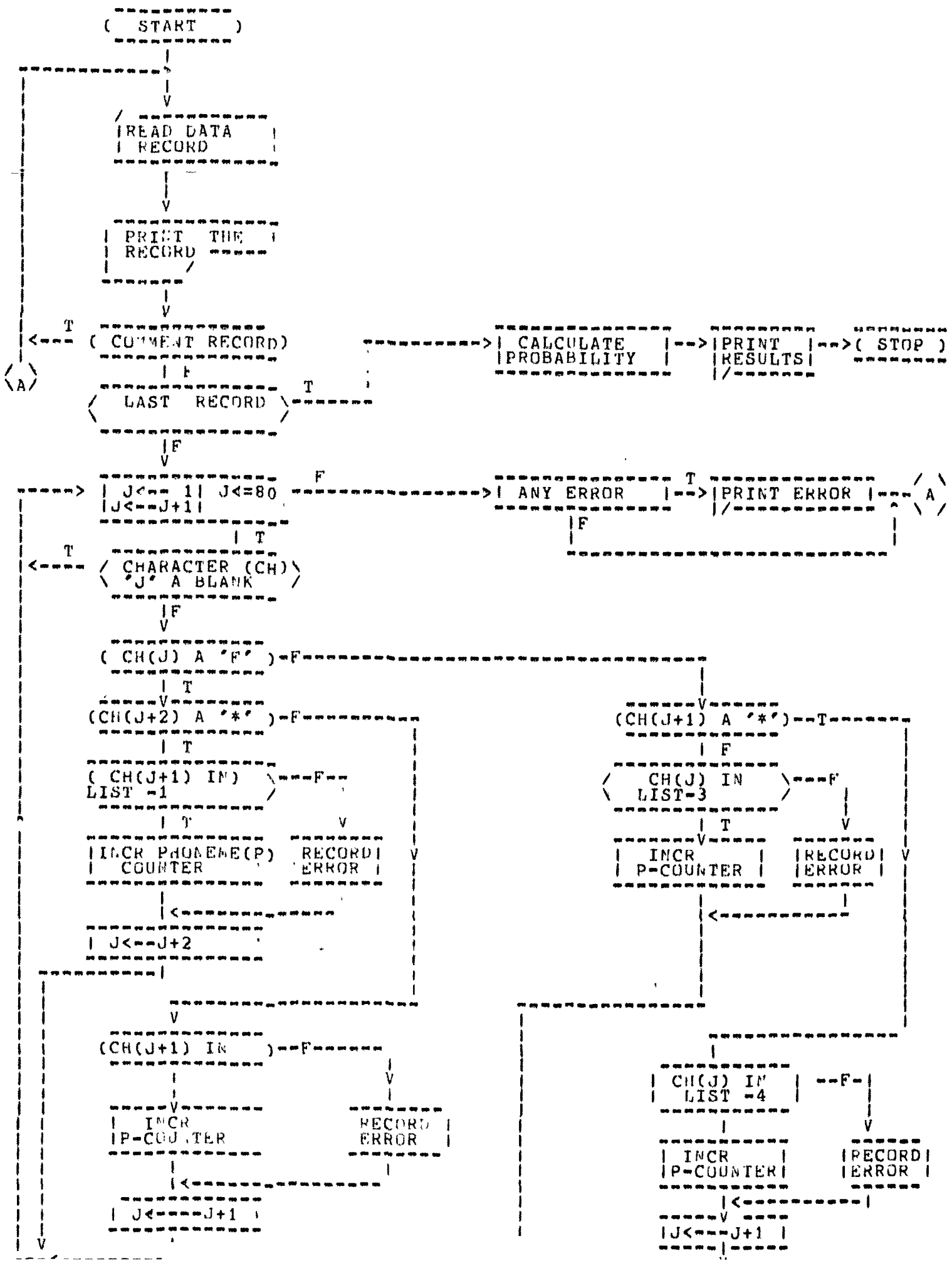
The Hindi characters in Devanagri orthographic representation, English key board code, and their probability of occurrence according to our processing are presented in Table (iv) and (v) (see Appendix- D also).

Table (iv) shows the Devanagri vowel letters and matras with the probability of their occurrence. Table (v) shows the Devanagri consonants and the probability of occurrence.

Results shows that अः(F:) found zero probability and अ(FA) has a maximum probability of occurrence (Table iv) among vowel letters of Devanagri. Matra A(-) has a maximum probability of occurrence . It is to be noted that this matras that occurred at the end of syllable have not been included in coding. Matra (-:): has a minimum probability of occurrence. Moreover A*(T) matra is second frequent matra present in our data.

Regarding consonants of Devanagri it is concluded that the consonants क(K) and consonant ऊ(:*) are most and least probable .The minimum frequency of occurrence is also made by consonant ॻ (Y*) on the same level as ऊ(:*) .The compound sounds like झ(FH*), क़(Q*), ज़ (Z*) have very small frequency of

FLOW CHART FOR PHONEME COUNTS OF HINDI TEXT CHARACTERS



Probability of [illegible] of occurrence
of Vowel letters and Matras.

FA (अ)	.00699	A (–)	.11622
FA* (आ)	.00636	A*(ा)	.07823
FI (इ)	.00508	I (ि)	.03655
FI*(ई)	.00266	I*(ी)	.03762
FU (उ)	.00662	U (ु)	.01378
FU*(ऊ)	.00020	U*(ू)	.00584
FE (ए)	.00513	E (े)	.05673
FE*(ऐ)	.00051	E*(ै)	.05238
FO (ओ)	.00135	O (ो)	.02524
FO*(औ)	.00355	O*(ौ)	.00141
FN*(अं)	.00004	V*(ं)	.03090
F: (अः)	.00000	: (–:)	.00031
		M*(ँ)	.00035

Table - IV

Probability of Frequency of Occurence of Consonants.

Code	Probability	Code	Probability
K (क)	.06011	K* (ख)	.00531
G (ग)	.01525	G* (घ)	.00174
C (च)	.00830	C* (छ)	.00267
J (ज)	.01552	J* (झ)	.00094
X (ट)	.00308	X* (ठ)	.00105
W (ड)	.00115	W* (ढ)	.00041
T (त)	.03209	T* (थ)	.00621
D (द)	.02038	D* (ध)	.00439
P (प)	.02298	P* (फ)	.00387
B (ब)	.01527	B* (भ)	.00775
M (म)	.03165		
N (न)	.04031	N *(ण)	.00107
Y (य)	.02598	Y* (ञ)	.00000
R (र)	.05636	R* (ड़)	.00383
L (ल)	.02596	L* (ढ़)	.00051
V (व)	.01855		
S (स)	.03637	S* (श)	.00644
H (ह)	.03590	FH* (ः)	.00004
Q (ष)	.00197	Q* (क्ष)	.00141
Z (ज़)	.00166	Z* (त्र)	.00039
:*(ं)	.0000		

Table - V

Comparison of Rank order of Frequency of occurence of consonants in various studies.

(Most frequent)

PRESENT STUDY	Ramakrishanan's	Tripathi's
K (क)	K (क)	K (क)
R (र)	R (र)	N (न)
N (न)	H (ह)	R (र)
S (स)	N (न)	T (त)
H (ह)	S (स)	S (स)
M (म)	T (त)	H (ह)
L (ल)	M (म)	Y (य)
T (त)	L (ल)	M (म)
Y (य)	P (प)	L (ल)
P (प)	Y (य)	P (प)
G (ग)	B (ब)	V (व)

Table - VI

Comparison of Rank order of frequency of occurrence of Vowel Letters.

Present Study		Tripathi	
अ	F1	उ	(FU)
उ	FU	आ	(FA*)
आ	FA*	अ	(FA)
ए	FE	ए	(FE)
इ	FI	ई	(FI*)
औ	FO*	इ	(FI)
ई	FI*	ओ	(FO)
ओ	FO	ऊ	(FU*)
ऐ	FE*	ऐ	(FE*)
ऊ	FU*	औ	(FO*)
अः	F :	अः	F :

Table - VII (b)

Comparison of Rank order of frequency of occurrence of Vowel Matras

Present Study		Tripathi	
◌	(A)	◌ा	(A*)
◌ा	(A*)	◌े	(E)
◌ि	(I*)	◌ि	(I*)
◌ी	(I)	◌ी	(I)
◌ो	(O)	◌ो	(O)
◌े	(V*)	◌ु	(U)
◌ु	(U)	◌ै	(E*)
◌ै	(E*)	◌ू	(U*)
◌ू	(U*)	◌ं	(V*)
◌ौ	(O*)	◌ौ	(O*)
◌ं	(M*)	◌ं	(M*)
◌ः	(:)	◌ः	(:)

*Tripathi is not considering Matra (A)

Table - VII (a)

Comparison of Rank order of frequecy of occurance of consonants in various studies (Most frequent)

(Least frequent)

Present study	Ramakrishna	Tripathi
ठ	ठ	ड.
ॠ	ॠ	ङ
ड.	ङ	ड
ट	ट	ध
ध	घ	घ
ष	ष	ण
फ	ण	फ
ह	ह	ह
घ	ड.	ष

Table - VIII

occurrence .

On a comparison of probability of occurrence of our study and with other study in Hindi we found that our frequently occurring characters are same as obtained by J.N.Tripathi and B.S.Ramakrishna although the rank orders are slightly different. Tripathi J.N. showed a seperate list of frequency of occurrence of half letters like क्, र्व्, त्र्. But we have not distinguished between half letters and a full letter consonants. so that the study of half letter had not been considered by us separetely.

A comparitive study of most frequent vowels, matras and consonants with Tripathi, J.N. and Ramakrishna, B.S. shown in the Table vi . On comparison we found that क(K) is declared as a most frequent consonant and ग(G), व(V), ब(B) are are other most frequent consonants in varying order in theses studies.

A comparitive study also made about least frequent consonants shown in Table (viii) . According to this table consonent ठ X*(ठ) , X* (ठ) and R*(ड़) are less frequent. A comparison of vowel matras and vowel letters can be seen in Table (vii) . On comparison it is to be noted that Tripathi did not considered the (-) matra. Almost the frequency of occurrence are same with us.

DIGRAM OF PHONEME

DIGRAM is defined as the probability of occurrence of other phonemes with respect to a given phoneme . It is well known that the variants of a phoneme are primarily dependent on the contexts in which the phoneme appears. This section presents the data relevent to such phonemic contexts.

To test the reliabilty of the data we generated tables for

	FA*	FE*	FH*	FI*	FO*	FU*	FA	FE	FI	FN	FO	FU	F:	A	B	C	D	E	G	H	I
FA*				.0021				.0003	.0005		.0003	.0005				.0005	.0034		.0068	.0021	
FE*																					
FH*																					.0003
FI*																	.0003				
FO*																					
FU*																					
FA				.0005											.0055	.0031	.0013		.0031	.0013	
FE															.0003	.0003			.0013	.0005	
FI								.0003	.0003					.0003		.0003					
FJ																					
FO																				.0003	
FU								.0008				.0003				.0016	.0023		.0047		
F:																					
A	.0013			.0083			.0003	.0003	.0013	.0008		.0003			.0249	.0135	.0333	.0016	.0299	.1694	.0008
B				.0003										.0800	.0010		.0021	.0070		.0005	.0101
C														.0239		.0031		.0075		.0005	.0086
D														.0364			.0023	.0327	.0008		.0400
E									.0003						.0052	.0005	.0057	.0008	.0075	.0039	
G														.0790				.0130			.0083
H								.0003				.0003		.0860				.0182			.0148
I			.0003					.0101			.0008			.0008	.0016	.0039	.0068		.0026	.0042	
J														.0548			.0003	.0078			.0190
K														.1541	.0003	.0003	.0003	.1364			.0818
L														.0543	.0003		.0018	.0416		.0005	.0533
M														.0800	.0042	.0005	.0005	.1122	.0003	.0013	.0275
N														.0907	.0003	.0005	.0166	.1128	.0016	.0120	.0247
O														.0003	.0018	.0052	.0039	.0003	.0200	.0044	
P				.0091					.0010					.1372	.0003	.0008		.0052		.0003	.0143
Q														.0060							.0010
R														.1761	.0021	.0073	.0078	.0405	.0039	.0005	.0275
S														.1450	.0008	.0008		.0842		.0005	.0234
T														.0725		.0003		.0385	.0003		.0314
U	.0073			.0065				.0060	.0003		.0021			.0013	.0018	.0031	.0078		.0008	.0018	.0010
V														.0714				.0130	.0010	.0003	.0465
W														.0018				.0016			.0010
X														.0081				.0057			.0018
Y								.0005						.0743				.0470			.0034
Z														.0026							.0044
A*				.0065	.0003	.0008		.0049	.0094		.0083	.0008		.0003	.0166	.0029	.0291		.0081	.0223	.0005
B*														.0205			.0003	.0029		.0003	.0057
C*														.0057				.0026			.0023
D*														.0143				.0023			.0060
E*									.0003						.0008	.0057	.0049				
G*														.0125				.0010			
H*														.0018			.0003	.0005			
I*								.0010							.0021	.0047	.0021		.0039	.0005	
J*														.0018				.0036			
K*														.0169	.0003			.0057		.0003	.0070
L*														.0008				.0003			.0005
M*																.0003		.0003	.0003		
N*														.0010			.0010		.0003		.0005
O*															.0003		.0005		.0008	.0003	
P*									.0010					.0088							.0130
Q*														.0026				.0042			
R*														.0081				.0068			.0021
S*														.0156		.0010		.0036			.0073
T*														.0083				.0088	.0003		.0086
U*								.0003							.0005	.0016	.0026			.0005	
V*	.0003	.0003						.0003						.0003	.0036	.0081	.0216		.0223	.0055	.0005
W*														.0013							.0005
X*														.0029				.0010			.0008
Z*														.0003							
81																					

Table -XII

	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	A*	B*	C*
FA*	.0060	.0016	.0018	.0013	.0034	- -	.0088	- -	.0026	.0088	.0060	.0005	.0036	- -	- -	.0065	- -	- -	.0003	- -
FE*	- -	- -	- -	- -	- -	- -	- -	- -	.0013	.0052	.0008	- -	- -	- -	- -	- -	- -	- -	- -	- -
FI*	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
FU*	- -	- -	- -	.0003	- -	- -	- -	- -	- -	.0003	- -	- -	- -	- -	- -	.0003	- -	- -	- -	- -
FU*	- -	- -	- -	- -	- -	- -	- -	- -	.0447	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
FU*	- -	- -	- -	- -	.0003	- -	- -	- -	.0008	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
FA	.0013	.0005	.0036	.0049	.0151	- -	.0213	- -	.0026	.0052	.0010	- -	.0029	- -	.0005	- -	.0008	- -	.0034	- -
FE	- -	.0247	.0010	.0018	.0005	- -	.0010	- -	.0003	.0039	.0003	- -	.0036	.0005	- -	.0005	- -	- -	- -	- -
FI	.0013	.0008	.0016	.0005	.0161	- -	.0005	- -	.0005	.0353	.0029	- -	.0003	- -	.0003	.0018	- -	- -	- -	- -
FU	- -	.0003	- -	- -	- -	- -	- -	- -	- -	- -	- -	.0003	- -	- -	- -	- -	- -	- -	- -	- -
FU	- -	- -	.0008	.0010	.0003	- -	- -	- -	.0029	- -	- -	- -	.0010	- -	- -	- -	- -	- -	- -	- -
FU	.0010	.0005	.0003	.0005	.0200	- -	.0060	- -	.0010	.0335	.0047	- -	- -	.0003	.0005	- -	- -	.0003	.0003	.0008
F:	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
A	.0153	.1052	.0792	.0935	.1720	.0003	.0179	.0034	.2785	.0434	.1260	- -	.0364	.0005	.0094	.0670	.0039	.0008	.0130	- -
B	.0010	.0005	.0008	- -	.0003	.0042	- -	- -	.0010	.0008	.0003	.0039	- -	- -	- -	.0003	- -	.0426	- -	- -
C	- -	- -	- -	.0003	.0005	.0031	- -	- -	- -	.0003	- -	.0088	- -	- -	- -	- -	- -	.0283	- -	.0034
D	- -	- -	.0005	.0047	- -	.0161	- -	- -	.0083	.0003	- -	.0068	.0101	- -	- -	.0008	- -	.0268	- -	- -
E	.0078	.0117	.0169	.0039	.0122	- -	.0010	.0021	.0125	.0075	.0208	- -	.0065	.0005	.0013	.0005	.0021	.0003	- -	- -
G	- -	- -	.0010	.0003	- -	.0125	- -	- -	.0127	- -	- -	- -	.0060	.0005	- -	- -	.0018	- -	.0325	.0003
H	.0003	- -	.0003	- -	.0010	.0551	- -	- -	.0008	.0003	.0003	.0304	.0003	- -	- -	- -	- -	.0525	- -	- -
I	.0031	.0379	.0426	.0070	.0312	- -	.0036	.0039	.0244	.0325	.0418	- -	.0130	.0005	.0021	.0935	.0010	.0003	.0049	.0044
J	.0016	.0003	- -	- -	- -	.0005	.0169	.0003	- -	- -	- -	- -	.0013	.0003	- -	- -	.0047	- -	.0559	- -
K	.0008	.0008	.0008	- -	- -	- -	.0764	- -	- -	.0109	.0018	.0166	.0187	.0008	- -	.0003	.0138	- -	.1237	- -
L	- -	.0029	.0068	.0091	.0005	.0190	.0018	- -	- -	- -	.0005	.0018	.0013	.0008	- -	.0003	.0010	- -	.0431	- -
M	.0013	.0003	.0008	.0065	.0010	.0107	.0096	- -	.0034	.0003	- -	- -	.0200	.0005	- -	.0008	- -	- -	.0559	.0036
N	- -	.0055	.0003	.0018	.0065	.0166	.0005	- -	.0003	.0016	.0104	.0073	.0018	.0016	- -	- -	.0104	.0034	.0642	- -
O	.0083	.0060	.0138	.0018	.0148	.0003	.0036	.0031	.0086	.0010	.0140	- -	.0021	- -	.0010	.0003	- -	- -	- -	.0005
P	.0005	.0008	.0008	- -	- -	.0016	.0023	.0003	- -	.0418	.0005	.0070	.0231	.0010	- -	.0005	.0003	- -	.0304	- -
Q	- -	- -	- -	- -	- -	- -	.0008	.0003	- -	- -	- -	.0044	.0005	- -	- -	.0036	.0005	- -	.0003	- -
R	.0029	.0023	.0005	.0086	.0075	.0190	.0005	.0036	.0008	.0023	.0068	.0130	.0096	.0016	.0021	.0078	- -	- -	.0753	.0005
S	.0003	.0133	.0018	.0047	.0013	.0047	.0039	- -	.0003	.0016	.0200	.0158	.0068	.0003	.0018	.0034	.0005	.0423	- -	- -
T	- -	.0010	.0010	.0018	.0044	.0226	.0026	- -	.0161	.0042	.0049	.0055	.0036	.0003	- -	.0047	- -	.0717	.0003	- -
U	.0023	.0127	.0203	.0047	.0088	- -	.0075	.0003	.0255	.0068	.0060	- -	.0021	- -	.0005	.0026	.0005	.0005	.0021	.0099
V	- -	.0008	.0003	- -	- -	- -	.0036	- -	- -	- -	- -	- -	.0003	.0003	.0005	- -	- -	.0125	- -	.0613	- -	- -
W	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	.0003	- -	.0042	- -	- -
X	- -	- -	- -	- -	- -	- -	.0008	- -	.0031	- -	- -	- -	.0005	- -	.0005	.0003	- -	.0036	- -	- -
Y	.0005	.0016	- -	- -	.0008	- -	.0361	- -	- -	- -	- -	.0003	.0070	- -	- -	.0008	- -	.1146	- -	- -
Z	- -	- -	- -	- -	- -	- -	.0026	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	.0026	- -	- -
A*	.0229	.0171	.0520	.0317	.0714	.0013	.0127	.0060	.1434	.0208	.0304	- -	.0135	.0010	.0021	.0400	.0039	.0013	.0018	.0003
B*	- -	- -	.0005	- -	- -	.0013	- -	- -	.0005	- -	- -	.0018	- -	- -	- -	- -	- -	.0283	- -	- -
C*	- -	- -	.0003	- -	.0003	.0023	.0003	- -	- -	- -	.0003	.0003	- -	- -	- -	- -	- -	.0070	- -	- -
D*	- -	.0003	- -	- -	- -	- -	- -	- -	.0013	- -	- -	- -	- -	- -	- -	.0003	.0065	- -	.0081	- -
E*	- -	.0018	.0052	.0055	.0052	- -	.0005	- -	.0044	.0096	.0016	- -	.0008	- -	.0005	.0031	- -	- -	- -	.0010
G*	- -	- -	- -	- -	.0005	.0026	- -	- -	.0008	- -	- -	.0008	- -	- -	- -	- -	- -	.0018	- -	- -
H*	- -	- -	- -	.0005	- -	.0005	- -	.0003	- -	- -	- -	- -	.0005	- -	- -	- -	- -	.0008	- -	- -
I*	.0010	.0057	.0083	.0057	.0117	- -	.0021	- -	.0062	.0026	.0094	- -	.0065	.0003	- -	.0122	- -	- -	- -	.0018
J*	- -	.0003	- -	- -	- -	- -	.0008	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	.0026	- -	- -
K*	- -	.0010	.0008	.0003	.0013	.0047	.0003	- -	- -	- -	- -	.0021	.0036	- -	- -	- -	.0047	- -	.0112	- -
L*	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	.0013	- -	- -
M*	- -	- -	- -	- -	- -	.0003	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
N*	- -	- -	- -	- -	- -	- -	.0003	- -	- -	- -	- -	- -	.0003	.0013	.0003	.0008	- -	- -	.0013	- -
O*	.0008	.0013	.0010	- -	- -	.0006	- -	.0003	- -	.0039	.0005	.0016	- -	- -	- -	- -	.0003	- -	- -	.0005	.0003
P*	- -	- -	- -	.0008	- -	- -	- -	- -	.0029	- -	- -	.0018	- -	.0023	.0008	.0003	- -	.0005	.0021	- -	.0060	- -	- -
Q*	- -	- -	- -	- -	- -	- -	- -	- -	.0003	- -	- -	- -	- -	- -	- -	- -	- -	- -	.0021	.0003	.0039	- -	- -
R*	- -	- -	.0008	- -	- -	- -	.0003	.0005	- -	.0003	- -	.0003	- -	.0003	- -	.0003	- -	- -	- -	- -	.0060	- -	- -
S*	- -	.0005	- -	.0013	.0023	.0010	- -	.0005	.0029	- -	.0010	.0039	.0057	- -	- -	.0021	- -	.0166	- -	- -
T*	- -	.0005	- -	- -	- -	.0008	- -	- -	.0005	- -	.0003	- -	.0003	- -	- -	.0005	- -	.0265	- -	- -
U*	.0010	.0021	.0057	.0029	.0029	- -	.0026	.0029	.0153	.0049	.0042	- -	- -	.0008	.0003	- -	.0003	- -	- -	.0010
V*	.0109	.0086	.0003	.0005	.0104	- -	.0034	- -	.0003	.0114	.0073	- -	.0036	.0023	.0023	.0018	.0039	- -	.0013	.0010
W*	- -	- -	- -	- -	- -	.0005	.0005	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
X*	- -	- -	- -	- -	- -	- -	.0003	- -	- -	- -	- -	- -	- -	- -	- -	.0003	.0003	- -	.0013	- -
Z*	- -	- -	- -	- -	- -	- -	.0005	- -	- -	- -	- -	- -	- -	- -	- -	- -	.0010	- -	.0021	- -
81	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -

Table - XIII

	D*	F*	G*	H*	I*	J*	K*	L*	M*	N*	O*	P*	Q*	R*	S*	T*	U*	V*	W*	X*	Z*
FA*	.0016	- -	.0003	- -	.0003	- -	.0005	- -	.0003	- -	- -	.0016	- -	- -	.0034	- -	- -	.0026	- -	.0010	.0003
FE*	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
FH*	- -	- -	- -	- -	.0026	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
FI*	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	.0005	- -	- -	.0005	- -	- -	- -
FO*	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	.0003	- -	- -	- -
FU*	- -	- -	- -	- -	- -	- -	- -	- -	.0003	- -	- -	- -	- -	- -	- -	- -	- -	.0008	- -	- -	- -
FA	.0062	.0026	.0003	- -	.0005	- -	.0021	- -	- -	- -	- -	.0008	- -	.0003	.0003	- -	- -	.0049	- -	- -	- -
FE	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	.0008	- -	- -	.0039	- -	- -	- -
FI	.0005	- -	- -	- -	- -	- -	- -	- -	- -	.0003	- -	- -	- -	- -	.0003	- -	- -	.0034	- -	- -	- -
FN	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
FU	- -	.0003	- -	- -	- -	- -	- -	- -	- -	- -	- -	.0003	- -	.0005	- -	- -	.0005	.0086	- -	- -	- -
FU	.0010	- -	- -	- -	- -	- -	.0008	- -	- -	- -	- -	.0010	- -	.0010	- -	.0016	- -	.0005	- -	.0016	- -
F:	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
A	.0047	- -	.0008	.0008	.0005	.0057	.0086	.0042	.0003	.0047	- -	.0078	.0088	.0340	.0117	.0125	- -	.0546	.0018	.0018	.0008
B	.0016	.0060	- -	- -	.0094	- -	- -	- -	- -	- -	.0005	- -	- -	- -	- -	- -	.0026	.0008	- -	- -	- -
C	- -	.0044	- -	.0005	.0029	- -	- -	- -	- -	- -	.0003	- -	- -	- -	- -	- -	.0005	.0003	- -	- -	- -
D	.0057	- -	.0005	- -	.0210	- -	- -	- -	- -	- -	.0031	.0003	- -	- -	- -	- -	.0065	- -	- -	- -	- -
E	- -	- -	- -	- -	- -	- -	- -	.0099	.0005	- -	- -	.0016	.0008	.0010	.0140	- -	- -	.1159	- -	.0013	- -
G	- -	.0010	- -	- -	.0063	- -	- -	- -	- -	- -	.0005	- -	- -	- -	.0003	- -	.0016	.0005	- -	- -	- -
H	- -	.1024	- -	- -	.0572	- -	- -	- -	- -	- -	.0008	- -	- -	- -	- -	- -	.0065	- -	- -	- -	- -
I	.0036	.0005	- -	.0018	- -	- -	.0073	.0003	.0003	.0005	- -	.0003	.0018	.0016	.0133	.0010	- -	.0151	- -	- -	.0016
J	- -	.0055	- -	- -	.0210	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	.0031	- -	- -	- -	- -	- -
K	.0003	.0049	- -	.0005	.0829	- -	.0010	- -	- -	- -	.0005	- -	- -	- -	- -	.0005	- -	.0036	- -	- -	- -	- -
L	- -	.0036	- -	- -	.0294	- -	- -	.0005	.0003	- -	.0029	- -	.0005	- -	- -	- -	.0003	.0026	- -	- -	- -	- -
M	- -	.0192	- -	.0005	.0055	.0003	- -	- -	- -	- -	.0018	- -	- -	- -	.0003	- -	- -	.0029	.0003	- -	- -	- -
N	.0023	.0021	- -	- -	.0298	- -	- -	- -	- -	- -	.0021	- -	- -	- -	- -	- -	- -	.0013	- -	- -	- -	- -
O	.0021	- -	- -	- -	.0003	.0003	.0008	- -	- -	- -	- -	- -	- -	.0042	.0023	.0008	- -	.0785	- -	.0003	- -
P	- -	.0044	- -	- -	.0075	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	.0114	- -	- -	- -	- -
Q	- -	- -	- -	- -	.0005	- -	- -	- -	- -	.0003	- -	- -	- -	.0010	- -	.0003	- -	.0005	- -	.0010	- -
R	.0018	.0029	- -	- -	.0413	- -	.0005	- -	- -	.0034	.0005	.0026	- -	.0008	.0021	.0029	.0088	.0003	- -	.0003	- -
S	- -	.0023	- -	- -	.0213	- -	- -	- -	- -	- -	.0026	- -	- -	- -	- -	.0112	.0052	- -	- -	- -	- -
T	- -	.0026	- -	- -	.0390	- -	- -	- -	- -	- -	.0005	.0003	- -	- -	- -	.0005	.0016	.0003	- -	.0003	- -
U	.0016	- -	- -	- -	.0016	- -	.0042	.0057	- -	.0005	.0003	- -	.0003	- -	.0010	.0021	.0005	- -	- -	.0088	- -
V	- -	.0047	- -	.0003	.0052	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	.0026	- -	- -	- -
W	- -	- -	- -	- -	.0003	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	.0003	- -	- -	- -	- -
X	- -	.0005	- -	- -	.0086	- -	- -	- -	- -	- -	.0003	- -	- -	- -	- -	- -	- -	.0003	- -	- -	- -
Y	- -	- -	- -	- -	.0184	- -	- -	- -	- -	- -	.0005	- -	.0003	- -	.0005	- -	.0049	.0005	- -	- -	- -
Z	- -	- -	- -	- -	.0044	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
A*	.0031	- -	.0003	- -	.0003	.0003	.0021	.0003	.0018	.0036	.0003	.0042	.0010	.0044	.0044	.0088	- -	.0356	- -	.0018	- -
B*	- -	- -	- -	- -	.0356	- -	- -	- -	- -	- -	.0005	- -	- -	- -	- -	.0005	.0068	- -	- -	- -	- -
C*	- -	- -	- -	- -	.0016	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	.0008	- -	- -	- -	- -
D*	.0003	.0005	- -	- -	.0049	- -	- -	- -	- -	- -	.0003	- -	- -	.0003	- -	- -	- -	- -	- -	- -	- -
E*	.0010	- -	- -	- -	- -	- -	- -	- -	- -	.0003	- -	- -	- -	- -	- -	.0008	- -	.0379	- -	.0023	.0016
G*	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	.0010	.0003	- -	- -	- -
H*	- -	- -	- -	- -	.0114	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	.0010	- -	- -	- -
I*	.0016	- -	.0008	- -	- -	- -	.0008	.0005	- -	- -	- -	.0026	.0021	.0010	.0003	.0003	- -	.0304	- -	- -	- -
J*	.0003	- -	- -	- -	- -	- -	- -	- -	- -	- -	.0003	- -	- -	- -	- -	- -	- -	.0003	- -	- -	- -
K*	- -	.0005	- -	- -	.0016	- -	- -	- -	- -	- -	- -	- -	- -	.0003	- -	- -	.0013	.0008	- -	- -	- -
L*	- -	- -	- -	- -	.0013	- -	- -	- -	- -	- -	- -	.0005	- -	- -	- -	- -	- -	- -	- -	- -	- -
M*	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
N*	.0008	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
O*	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	.0003	- -	.0029	- -	- -	- -
P*	- -	.0034	- -	- -	.0029	- -	- -	- -	- -	- -	.0003	- -	- -	- -	- -	- -	.0005	- -	- -	- -	- -
Q*	- -	- -	- -	- -	.0010	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
R*	- -	- -	- -	- -	.0070	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
S*	- -	- -	- -	- -	.0055	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	.0003	.0008	- -	- -	- -
T*	- -	.0013	- -	- -	.0158	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
U*	- -	- -	- -	- -	- -	.0003	.0008	.0008	.0010	.0003	- -	.0003	- -	- -	- -	- -	- -	.0057	.0003	- -	- -
V*	.0065	- -	.0023	- -	- -	- -	.0016	- -	- -	- -	- -	- -	.0003	- -	.0018	- -	- -	.0005	.0003	- -	.0005
W*	- -	- -	- -	- -	.0003	.0016	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	.0008	- -	- -
X*	- -	- -	- -	- -	.0039	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	.0003	.0003	- -	- -	- -
Z*	- -	- -	- -	- -	.0003	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
81	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
	38490.00		38490.00		38490.00				38490.00			9.999978									
	9.999978		9.999978																		

Table - XIV

the probability of DIGRAM sequences. These are given in Table XII, XIII and XIV. The DIGRAM were created using a (63x63) matrix (63=number of characters taken and blank/space). Since all the entries in each row could not be accomodated on one line of computer paper, then the matrix was devided into three parts. These parts shows the matrix of (63x21) columns or DIGRAM probability for the 21 characters each. The probability of characters which is very small has been omitted and is shown by the dash (-).

A computer program (see Appendix-E)is made for obtaining these results. The program description is like this that a 2 dimension counter IREC(I,J) was initialized . Now for each word on identification of first character of word its serial number becomes row index of IREC counter. The following character serial number becomes column number of IREC counter. After obtaining row and column indices the IREC(I,J) is incremented by one, the process is repeated characters,words and then for allwords for all words of corpus. Finally IREC(I,J) is devided by the DIGRAM pairs processed to get the DIGRAM probability (63x63) as mentioned in the preceding paragraph. Please keep in mind that blank/space is also treated as one of the characters.

LEFT RIGHT CONTEXTS OF PHONEME

(For each character)

If / α / and / / appears adjacent in the order /β /then we say /α/ is the left context of /β/ and /β/ is the right context of / α /$\beta\gamma$/occurrs in as string of phonemes then the pair /α / and /β/ is said to be the left -right context pair of /β/.

THE THREE MOST COMMON LEFT AND RIGHT CONTEXT FOR EACH PHONEME

O A V*		FA*	S P Y	- - -		FE*	S R T	B - -		FH*	I* L -	O A U		FI*	S* V* -	- - -		FO*	R V* -	- - -		FU*	R V* -	- - -		FA	P N D*
I U A*		FE	K S V*	A* O -		FI	S N V*	- - -		FN	K U -	A* I -		FO	V* R A	A* - -		FU	S N P	- - -		FN:	- - -	K S P		A	R N H
A A* E		B	A A* E	A R O		C	A* A U	A* A .		D	V* I E	K N M		E	A* T L	A V* O		G	E* A* R	L A* N		H	Y A I*	A* V D		I	A* L -
A* A V*		J	A* A I*	A I FE		K	A F A*	A A* I		L	A I A*	A A* L		M	E A A*	A A* I		N	E A A*	K I Y		O	V* G N	FA A* A*		P	A R A*
A* I A		O	A T X	A A* P		R	A A* I*	A I FI		S	A E A*	A I A*		T	A A* I*	A P K		U	A L K	H A* D		V	R A* 1	A N A*		W	A A E
A O V*		X	J A E	I A A*		Y	A* A E	A N -		Z	I A A	K Y R		A*	R N Y	A I FE		B*	I* A* E	U 1 C		C*	A* A E	FE E A		D*	A A* Y
H M B		E*	V* S C	V* A -		G*	A O A*	I U -		H*	I* A -	K H R		I*	V* T L	A U -		J*	E A* -	E A I		K*	A A* E	A L* -			A* - -
A* U* -		'*	C - -	A A* R		N*	A* D D*	D I, S		O*	V* R K	A A* I		P*	I A A*	A I A*		O*	E A* A	A A* O		R*	A I* E	E I A*		S*	A* A I
A S A*		T*	A* I* E	P R O		U*	R V* S	E O A*		V*	G D S	A W* -		W*	I* A -	A - -		X*	I* A A*	I - -		Z*	A* - -	AVNEESH AND S.K.GUPTA			

Tabla XV

Three most probable left-right context of each character of Devanagri have been deduced from the results obtained from the DIGRAM sequences and are presented in Table (XV) . The table has been arranged in (9x7) matrix of our code in English alphabetic order for long vowel character, short vowel character then alphabet and alphabet followed by asterisk row wise.

The result shows that on the right context of vowel letter (F# or F##) the consonant S (स), N (न), R (र) and vowel matra V* (ं) have occurred. On the left context of the vowel letter the vowel matra (U) and consonant ब (B) have occurred. On the left context of vowel matra , consonants occurred frequently. The consonants are क(K), ह(H), र (R), ल(L), य(Y), म (M), च(C). On the right context of vowel matra, the vowel matra (V*) and consonents ल(L), य(Y), ग(G), र(R), म(M), त (T), स(S) have occurred.

As far as the consonants left-right contexts are concerned vowel matra has occurred on the left context. These vowel matras are largly ा (A), ी (A*), ि (I). On the right context we find that the vowel matra has occurred frequently . The matras are mainly ा (A), ी (A*), ि (I).

WORD COUNTING

Our aim of the study is to find out the most frequent words present in our corpus of the statistical studies collected from the different sources. So as to undertake acoustical phonetic studies which may from data base for Hindi speech recognition and synthesis studies.

The digital computer was well suited for use in the present study in that it can sort,compile, and compute the words. It has capaibility of scanning entire corpus,pickout certain combination, compute its frequency of occurrence,absolute frequencies, arrange them in order of frequency and print the result with accuracy than any investigator or team of investigators could do manually. For example Godfrey Dewey,(The relative frequency of English speech sounds) mentions that the analysis of sounds according to their occurrence initially, medially or finally in words and syllables took about 720 hours to perform. Work of similar nature were carried out by computer program (Appendix- F) in the present study.

RESULTS AND DISCUSSIONS

Frequent words occurred in our corpus in Hindi orthographic form are presented in the form of table(Appendix G.)

A list of most frequent words categories in a different manner by the point of view of frequencies shown in the Table. IX & X . The words which are having frequency more than 100 are summerise as .

1. KE
2. MEV*
3. NE*
4. KI*
5. SE
6. KO

7. KA*
8. FO*R
9. KI
10. NE
11. KAR
12. PAR
13. B*I*

The whole list is quite important by the point of view of statistical analysis. The word /PA*JA*B/ has occurred more due to the recent happenings there.

The following words shows that our corpus is related with criminal activities as we have already said that to make a general corpus for the study we select sources of common interest.

1. PULIS
2. PAV*JA*B
3. G*AXANA*

The following words shows the data is also from games news

1. ME*C
2. HA*R
3. CE*MPIYAN

'P*ILM' have occurred as we have taken corpus from film magazine.

The most frequent words are very similar to those reported for Urdu (Table XI) presented by Khan et al 1984. A comparitive study is also made with most frequent word of Urdu the language which is similar to Hindi

MOST FREQUENT WORDS : COUNT (K) FROM 15,031 WORDS

के	में	है	को	से	को	का	और	कि	ने	कर	पर	भी
KE	MEV*	HE*	KI*	SE	KO	KA*	FO*R	KI	NE	KAR	PAR	B*I*

नहीं	हैं	एक	इस	हो	गया
NAHI*V*	HE*V*	FEK	FIS	HO	GAYA*

यह	ही	था	वह	दिया	थी	पुलिस
YAH	HI*	T*A*	VAH	DIYA*	T*I*	PULIS

किया	दी	बाद	कुछ	कहा	लिये	कोई
KIYA*	DI*	BA*D	KUC*	KAHA*	LIYE	KOFI*

में	करने	भारत	क्या	द्वारा
ME*V*	KARANE	B*A*RAT	KYA*	DVA*RA*

पंजाब	तथा
PAV*JA*B	TAT*A*

तक	उस	थे	न	समय	रहे	अपनी
TAK	FUS	T*E	NA	SAMAY	RAHE	FAPANI*

हुई	तरह	लिये	होने	हुआ	काम
HUFI*	TARAH	LIFE	HONE	HUFA*	KA*M

बहुत	रहा	जा	हुए	उसके	उन्होंने
BAHUT	RAHA*	JA*	HUFE	FUSKE	FUNHOV*NE

घटना	उसे
G*XNA*	FUSE

Table-IX

K = 19	पहले	दो	आज	जब	प्राप्त	व	वे
	PAHLE	DO	FA*J	JAB	PRA*PT	VA	VE
K = 18	अब	हम	बात	अपने	रही	बार	या
	FAB	HAM	BA*T	FAPNE	RAHI*	BA*R	YA*
K = 17	लेकिन	यहाँ	मैच	हार			
	LEKIN	YAHA*V*	ME*C	HA*R			
K = 16	आप	वाले	पास	जाने	होगा	इन	
	FA*P	VA*LE	PA*S	JA*NE	HOGA*	FIN	
	लगा	दोनो					
	LAGA*	DONO					
K = 15	विश्व						
	VIS*V						
K = 14	फिर	जाता	बारे	होते	मार्च		
	P*IR	JA*TA*	BA*RE	HOTE	MA*RC		
	लिया	लोग	लोगों	किसी			
	LIYA*	LOG	LOGOV*	KISI*			
K = 13	फिल्म	दिन	सिंह	तीन	मेरे		
	P*ILM	DIN	SIV*H	TI*N	MERE		
	चैम्पियन						
	CE*MPIYAN						

Table - X

Comparison of 20 most frequent words of Hindi with Urdu

Hindi	Urdu
KE	KE
ME*V*	KI*
HE*	ME*V*
KI*	NE
SE	SE
KO	FO*R
KA*	HE*
FO*R	T*T*
KI	KA*
NE	KAR
KAR	MEV*
PAR	FUN
B*I*	B*I*
NAHI*V*	KO
HE*V*	FEK
FEK	MUJ*E
FIS	VAH
HO	TO
GAYA*	T*E
YAH	KI

*. Urdu words are given by Khan et al (1984)

Table - XI

Chapter 3

Speech synthesis

INTRODUCTION

Speech synthesis is the artificial production of speech sound from the phonetic transcription of a message. Production of human speech sounds mechanism is fully understood by the researchers and the emphasis is giving on the acoustic understanding in speech synthesis area.

HISTORY OF SPEECH SYNTHESIS

Traditionally history of speech synthesis goes back to Greeks and their fake 'speaking statue '.There then seems to be a gaping hole in history, at least concerning speech synthesis, until the eighteenth century, with renewed interest in its sciences.

The first example of mechanical analog of the vocal tract is attributed to Kratzenstein around 1780, in response to a scientific competition set up by the Imperial academy of st Petersburg . His machine consisted of a set of acoustic resonators, excited by a vibrating reed, mimicking the shape of the vocal tract for the production of 5 vowels.

In France, around the same period, a priest, named Mical, built a two headed machine based on the principle of music box. The two heads exchanged a couple of sentences in a manner of speaking.

But the true first attempt at understanding and reproducing the generation of sounds in the vocal tract was undoubtly

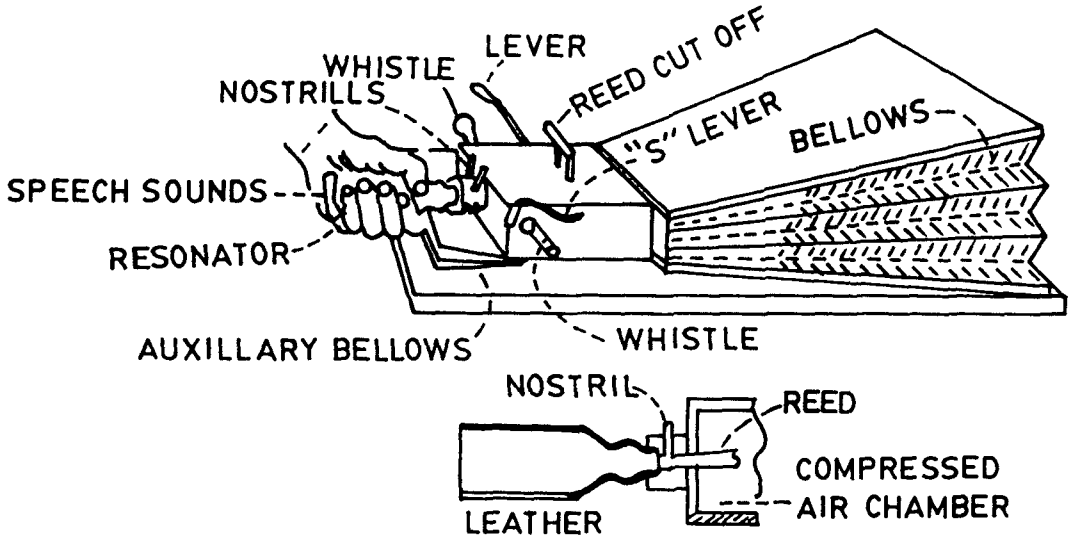


FIG. 2 SYSTEMETIC DIAGRAM OF VON KEMLEN MACHINE

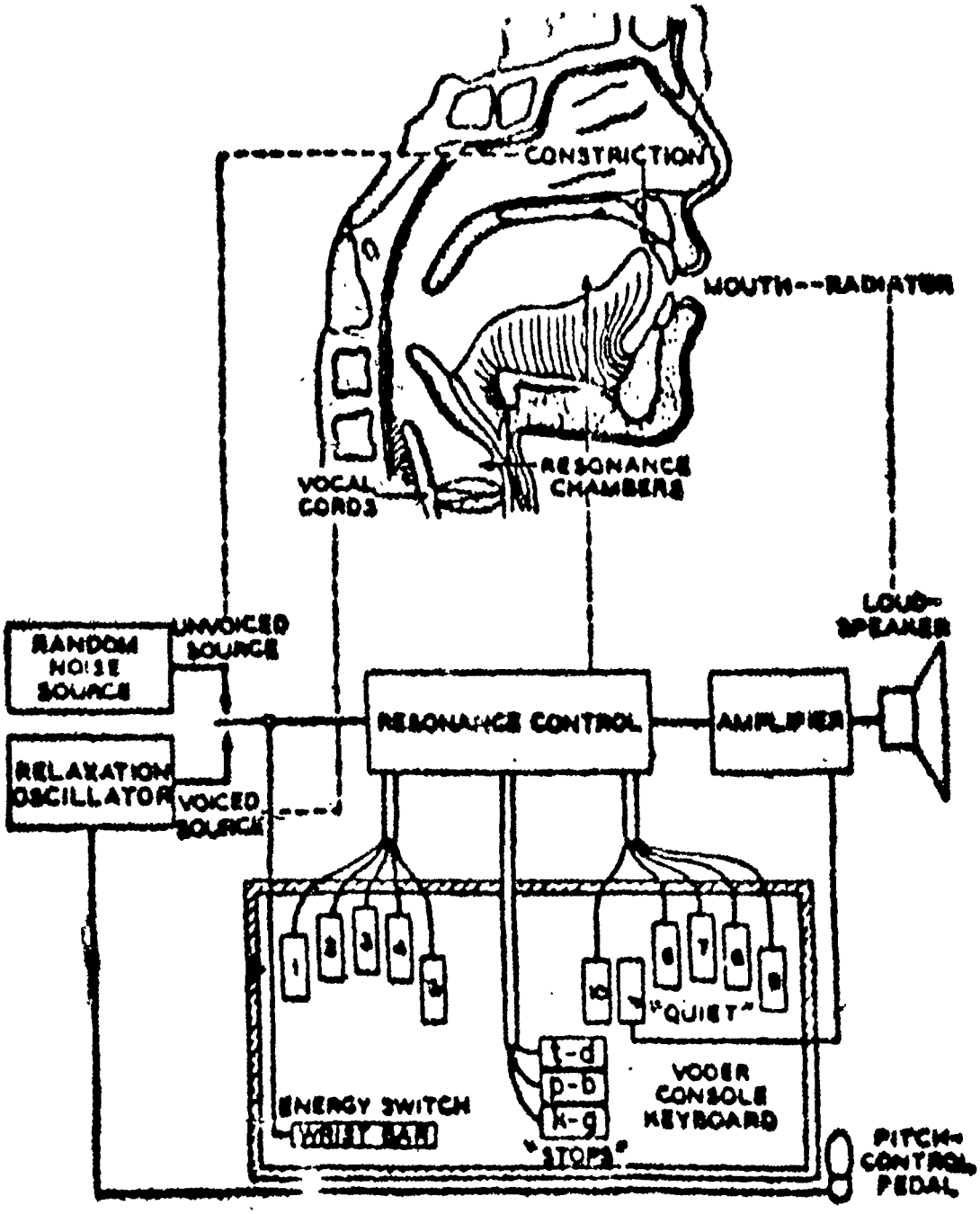
made by Von Kemelen in 1791. Here is a description of his machine (see Dig.2). It used a bellows to supply air to a reed which in turn, excited a single, hand-varied resonator that produced voiced sounds. Consonants, including nasals, were simulated by four separate constricted passages, controlled by the fingers of the other hand.

A few more machines were built in the ninteenth century. They were generally improvements upon the Kemelen machine, with movable tongue and jaws for example (Faber in 1835, and even A.G.Bell). But these machines were doomed to remain scientific curiosties because their operator had to be a virtuso. Also, the scientist had no way to compare the sounds output by their machines to real speech sounds. This is probably the explanation for the other gap in speech synthesis history, until the twentieth century and the appearence of electrical speaking machines.

In 1922 J.Q. Stewart built the ancestor of formant synthesizer . His machine consisted of a periodic source and of two electrical reonators and allowed to reproduce vowels, diphthongs and a few words like 'mama','anna' etc.

But undoubtedly, the one most important date in the history of speech synthesis is 1939, with the presentation of Homer Dudley's(29) VODER (voice operation demonstrator)(see Dig.3) at the New York world's Fair .Actually the voder although introduced first was derived from the Vocoder by subsitituting manipulating for automatic controls.

The first example of real speech synthesizer appears in 1950 at Haskins Laboratories with PATTERN PLAYBACK . This machine can be considered as a sonograph machine working in



Schematic diagram of the VODER

FIG % 3

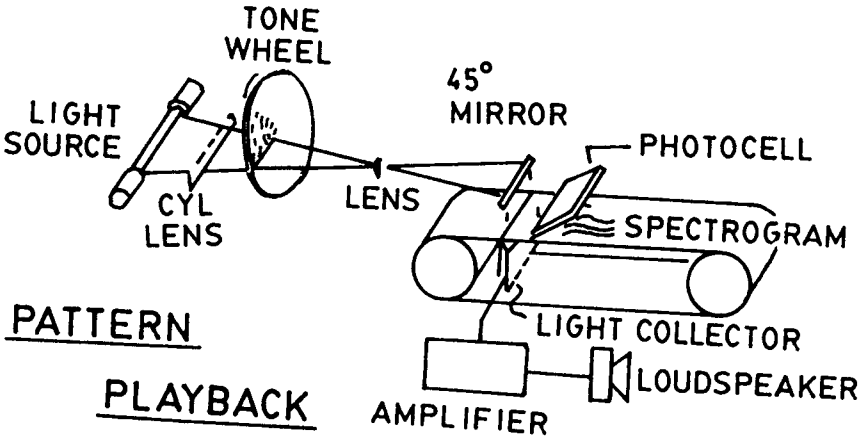


FIG. 4 SYSTEMATIC DIAGRAM OF PATTERN PLAYBACK SYSTEM

reverse . The sonograph transformers recorded speech into 3 dimensional plot, the two first dimension being time and frequency,. the third one being intensity, represented on a gray scale .Conversely, by drawing schematic evolutions of formant frequencies on a glass plate, and by scanning this spectrogram along the time axis (using a set of frequency modulated light beams and a light collector that is fed into a loudspeaker), one can actually hear the sound corresponding to the spectrogram.

The extensive use of spectrograms togather with the PATTERN PLAYBACK (see Dig.4) allowed for much progress in the study of speech production and speech perception and showed the imporatnce of the transitions between different speech sounds.

In early fifties, following the fundamental work by Chiba and Kajiyama(30) the first electrical analogs of the vocal tract as a succession of short tube were investigated. The diameter of each section can be varied so as to represent the variations of the cross-sectional area along the vocal tract, i.e the area function. The area function is often represented in terms of articulatory parameters such as aperture and place of articulation .

Around the same period (1953) , the first formant synthesizer were developed by Lawrence in England (Parametric Artificial Talker, or PAT) and Fant in Sweden (The Orator Verbis Electricals or OVE series), and then later at MIT , Bell Laboratories etc.

Then another revolution took place with the rapid development of computers and the simultaneous advances of digital

signal processing theory. This technological revolution allowed for the design of computer-simulated speech synthesizers. Simultaneously, computers made possible the study of lingustic and semantic aspects of speech.

Two different approaches were chosen and are still being investigated to date.

First approach: given a model for speech production , one tries to approximate the speech signal as well as possible by varying the parameters of a recursive digital filter. This approach include Linear Prediction and Formant synthsis.

Second approach : if all the articulatory parameters and their evolution during speech production are known one can simulate the propagation of sound through the vocal tract, using physiological and mechanical data on the vocal tract shapes, the vocal chords, the vocal tract walls, the lips etc.

SPEECH SYNTHESIZER

We can classify the speech synthsis techniques into three groups although these three might slightly overlap:

1- Direct generation

2-Generation through a model

3- Vocal tract simulation

Group 1 include the techniques as waveform manipulations and channel vocoders, Group 2 will include formant and LPC synthesis and Group 3 articulatory synthesis.

Our implementation is of formant synthesizer so we would like to discuss the second group. The technique involved

here tries to generate a speech waveform throgh a speech production model. The parameters for this generation are generally derived by minimization of an error criterion between the original speech and the model.

Formant Synthesis

Formant synthesis originated in early 1950s, with a worl by Lawrence and Fant. As sound propogates from the glottis to the lips, the broad spectrum of the excitation source is shaped by the frequency selectivity of the vocal tract. The correspoding resonant frequencies are called formants. The goal of formant synthesis is to generate a speech spectrum from information on these formants, notably the formant frequencies and bandwidths.

Formant synthesizers generally use second order filters. There are two possible ways to arrange these filters together, namely cascade or parallel association.

Clearly, the cascade configuration only allows for poles in the vocal tract transfer function which is naturally insufficient to represent all speech sounds. In addition, the amplitude of higher formants is a fuction of the amplitude of lower formants, because the later induce a slope in the spectrum, of 12 dB per octave: however this phenomenon is observed in real speech spectra.

The parallel configuration of two-pole filters is much versatile by the addition of second order transfer functions, one can obtain an overall transfer function with poles and zeroes. Moreover the relative amplitudes of the formants are not constrained by the slope relationship of the cascade form.

Advantages of Formant synthesis

Formant parameters are closely related to speech production and sound propagation in the vocal tract. Therefore formant synthesizers can produce "smooth sounding " synthetic speech, if the continuity of formant parameters is repected. In addition, the excitation of such synthesizers can be composite, voiced and unvoiced, and different types of excitation can be associated with different parts of the spectrum in the parallel form.

Drawbacks

The main problem with formant synthesizer is aquiring data to operate them. Formant tracking is a very difficult task, which has not been totally automated so far. The measurement of formant bandwidths is even more difficult than that of formant frequencies. The difficulties arise especially when two formants are close or when a formant sits on top of a spectral zero.

In conclusion formant synthesis can produced excellent synthetic speech, but the acquisition of data can be painstaking, and the final parameters values must be determined by trial and error methods.

KLATT SYNTHESIZER

Klatt software (Appendix-H)is cascade/parallel formant software synthesizer and simulated on a general purpose digital computer in the manner given in Fig.5.

Prgram Details

There are 39 control parameters that determine the

characterstitics of the speech output. The name and the range of values for each parameter are given in Appendix-I . One might wish to vary as many as 20 of the 39 parameters as a function of time to achieve optimum matches to an arbitrary Hindi utterence and to serve as an input to the waveform generating synthesizer subroutine PARCOE.FOR and COEWAV.FOR.

Synthesizer control parameter data such as the frequency variation of the first formant as a function are specified by the experiments.

Output waveform samples are computed in nonreal time and stored on a disk for subsiquent playback through a digital to analog converter, analog lowpass filter and loudspeaker.

Waveform Sampling rate

Most of the sound energy of speech is contained in frequencies between about 80 and 8000 Hz. So the digital sampling rate of the synthesizer is 100000 samples/sec.

Parameter update rate

Control parameter values are updated every 5 ms. If desired the program can also be set for updating after 10ms.

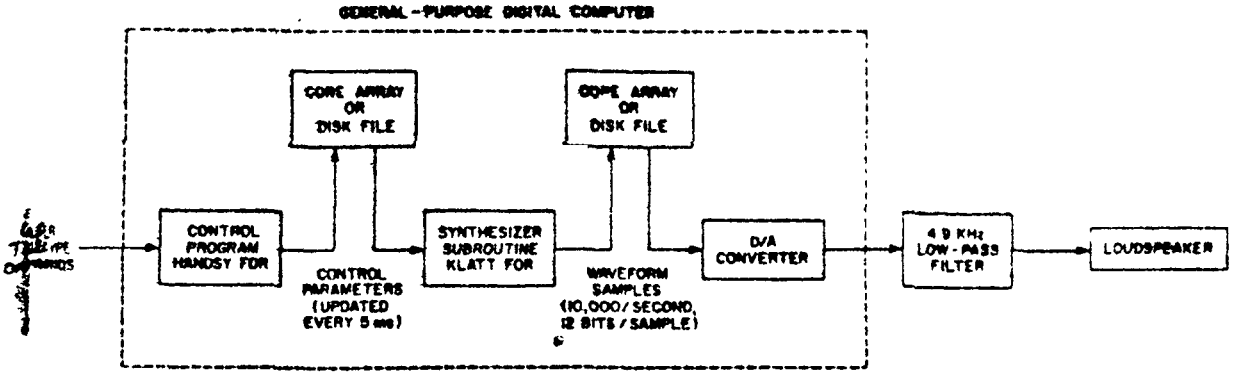
Sources of Sounds

SYNTHESIS STRATEGY

The step used to synthesize an utterance is given below.

a. SYNTHESIS OF VOWELS

The control parameters that are the amplitude of voicing AV, the fundamental frequency of vocal fold vibrations F0, the lowest three formant frequencies F1,F2 and F3, and their bandwidths B1,B2 and B3. The fourth and fifth formant



Relation of the software synthesizer to the hardware and supporting software of a small general-purpose digital computer

FIG. 5

frequencies may be varied to simulate spectral details, but this is not essential for high intelligibilty. To create a natural breathy vowel termination, the amplitude of aspiration AH and amplitude of quasi-sinusoidal voicing AVS can be activated.

SYNTHESIS OF CONSONANTS

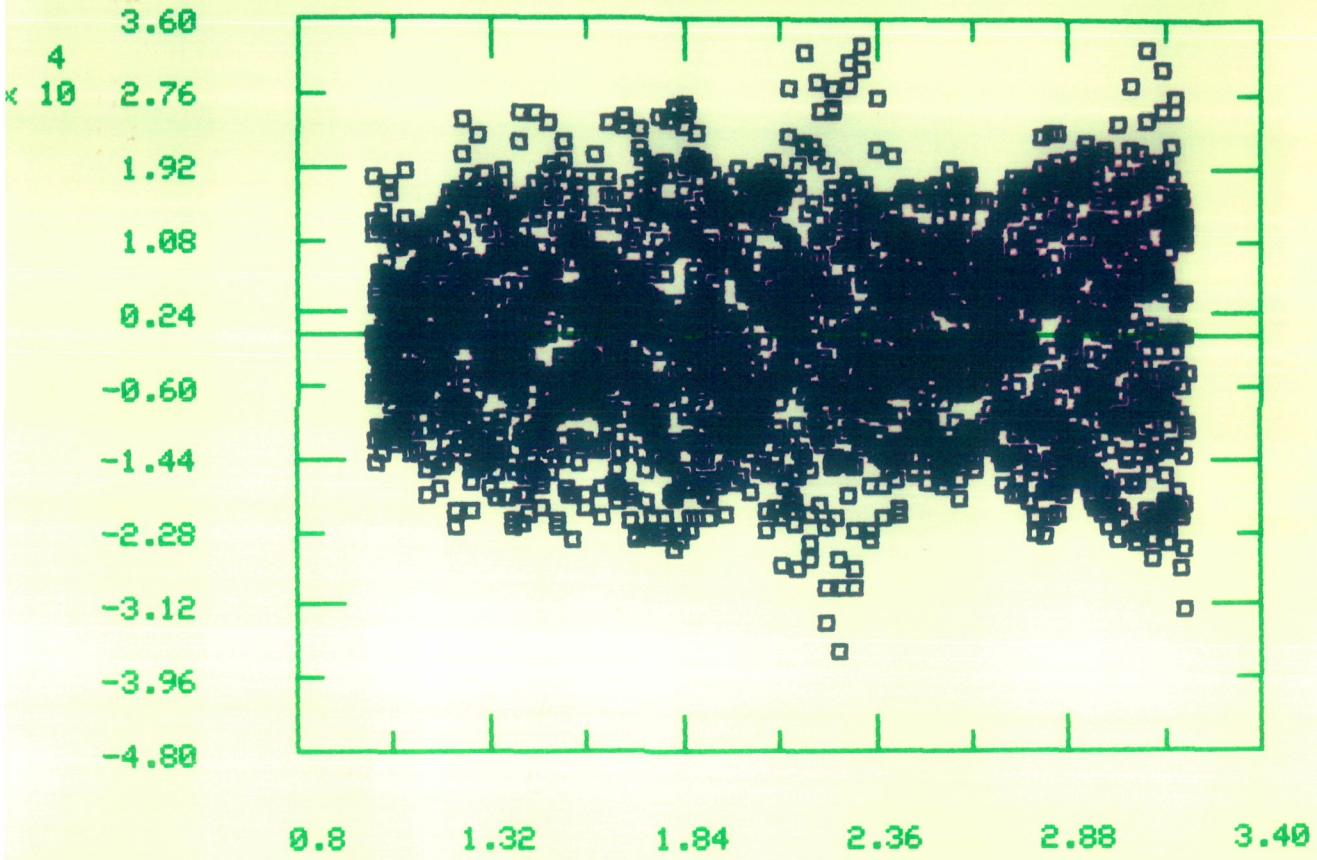
The vowel is to be preceded by a consonant , additional control parameters may be varied like FNP,FNZ, on the basis of spectral studied data.

IMPLEMENTATION

We implemented the Klatt synthesizer on VAX-11/780 for the generation of Hindi Vowel. The parameters used for the vowel is given in Appendix- J . We have deactivated the parameter update strategy.

RESULTS AND DISCUSSION

The Output data given by Klatt synthesizer using our acoustical parameters is given here and on the basis of the data obtained we tried to draw a output waveform (see DIG. 6). We would like to do the FFT of our obtained outout data and will undertake perception experiments.


4
x 10
3.60
2.76
1.92
1.08
0.24
-0.60
-1.44
-2.28
-3.12
-3.96
-4.80
0.8
1.32
1.84
2.36
2.88
3.40
SYNTHESISED HINDI VOWEL
X x 10^3

B I B L I O G R P H Y

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A P P N D I X

HINDI SCRIPT COLLECTION FROM VARIOUS MAGZINE

App-(A)

$ SUQAMA* P*ARAVARI* 82
$ SUQAMA* P*ARAVARJ* 82 KRAM 00
$ KRAM TI*N
$ NAVB*ARAT 16 JANAVARI PEJ 3 KA*LA' 5 LOFAR HA*P*
$ GREEN PAGE 1 FOLLOWS :
$ NAVAB*A*RAT, 10 JANAVARI*, PEJ 8, ROWWISE PER COLUMN
$ COLUMN CHANGE
$ COLUMN CHANGE
$ GREEN PAGE 2
$ COLUMN CHANGE(PAGE 8, COL 4, NAVBHARAT JAN 10)
$ COLUMN CHANGE
$ COLUMN CHANGE (ADVERTISEMENT)
$ HINDUSTAN TIMES DATED 22 ND, OCT, 1982 PAGE 4
$ CHANGE OF COL.
$ COL CHANGE COL_3
$ COL CHANGE COL_4
$ COL CHANGE COL_6
$COL CHANGE COL_5
$ PAGE_2 OF CODED TEXT
$ CHANGE OF TWO COL COL_7
$ COL CHANGE COL-8 THE LAST
$ NEXT PAGE COL 3
$ COL CHANGE COL-4
$ CAV*PAK P*ARAVARI* 1981 SECOND
$ PAGE 7
$ PAGE 11
$ PAGE 14
$ PAGE 17
$ PAGE 18
$ PAGE 23
$ PAGE 27
$ PAGE 32
$ FROM FAPARAD*O KI DUNIYA* B*A*G-1 CARE INDRAJAL COMICS
$ END OF RHS PAGES SECOND ROW OF DIAGRAM
$ INDRAJAL COMICS SNO. 385 K*U*N1* JANARAL B*A*G .
$ LEFT PAGE THIRD PICTURES RED INK MARKED .
$ JANATA* YUG SITAMBAR 13, 1983
$ COL. CHANGE ADVERTISEMENT
$ AMARUJALA 23 FEB
$AMARUJALA 23 FEB
$ AMARUJALA 23 FEB
$AMARUJALA 23 FEB
$ NISHANT
$NISAT MAG PAGE4 WRITTEN BY SYED HAMID
$ MAG NISHANT PAGE 1-15
$ MAG NISHANT PAGE 1-15
$FILMEE KALIYAN :GUST 1985 PAGE18
$PAGE 28
$PAGE 39
$PAGE 49
$PAGE 53.
$PAGE 68
$PAGE 74.
$PAGE 80.
$PAGE 84
$PAGE 97.
$SARITA PAGE 18 COL 1(OCT 1985 (FIRST))
$COLUMN CHANGE
$COLUMN CHANGE
$SARITA PAGE 10 COLUMN 4 CONTINUE FROM PREVIOYS ONE
$ SARITA COL 1 PAGE 20
$COL CHANGE 2
$COL CHANGE 3
$ SATYAKATHA APRIL PAGE 22 COL-1
$COL- CHANGE -2
$ COL CHANGE -3
$SAYAKATHA PAGE -30 COL 1
$COL CHANGE
$COL CHANGE 3
$COL CHANGE 4
$PAGE 42 COL-1
$COL CHANGE
$COL CHANG
$COL CHANGE
$ SATKATHA PAGE 94 COL CHANGE 1
$ PAGE 98 COL 1
$ COL CHANGE 2
$PAGE 29.
$PAGE 37.
$ PUNJAB KESRI DATED 21 MARCH 1986 FRONT PAGE COL 6 HEAD MAJDAKINI
$PUNJAB KESRI COL 1 NEWS "RUKAWAT KE LIYE KHED HAI"
$ PUNJAB KESRI DATED 21 MAR PAGE 4 HEAD PUNJAB ME TEJI SE BIGARTE HALAT
$ GANDEEV :: 1 APRIL 1986.
$ NEWS PAPER GANDIV EASTERN ZONE PUBLISHED FROM GHAZIPUR
$ COL CHANGE HEAD DAHEJ HATYAYE,JANMANAS FO*R KANU*N
$ COL CHANGE

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$ COL CHANGE
$ COL CHANGE
$ HEAD CHANGE PAPER  GA DIV  PAGE 6 COL 1 DATED 1 APRIL
$ HEAD KUA* SA*F KARANE KI *A*V*G
$ COL CHANGE 2
$ HEAD CHANGE K*OJAVA*V* KE LA*PATA*"
$ HEAD FEK FAPRE*L KO MURGA* BA'E
$HEAD FA*V*TAKVAD KE VIRUD* KARI* KA*RVA"
$ COL CHANGE 3
$HEAD B*ARTIYE PAJDU*R SAV*G*
$ PAPER GANDIV 1 APRIL PAGE 6 COL 1 HEAD GRAH VIGYAN PARI*C*A*
$ COL 2
$ COL CHANGE
$ COL CHANGE
$ HEAD HALIYA* DEV*NATYA*
$ PAPER GANDIV DATED 1 APRIL 1986 FRONT PAGE HEAD BIRZU
$COL CHANGE
$ COL CHANGE
$ PAPER GANDIV DATED 1 APRIL 1986 FRONT PAGE HEAD BIRZU
$COL CHANGE
$ COL CHANGE
$ GANDEEV :: 1 APRIL 1986.
$ GANDEEV :: 1 APRIL 1986.
$HINDI PAPER GANDEEV.
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TOTAL MAGZINE NEWS PAPER =  110
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SARITA.DAT;2 7-NOV-1987 11:09:00.45 Page 1

FIS VIQAY MEV* YAH D*YA*N RAK*NE KI* BA*T HE* KI FIV*DIPA* GA*V*D*I*
KE JAMA*NE MEV* P*II*ROJ GA*V*D*I* KA* NATO FA*L FFIV*WYA* REBIYO NE NA
DURDARS*AN NF KAB*I* KOFI* JIKR KIYA* NA KAB*I* FUN KI* BARASI* KE
KA*RYAKRAY PRASA*RIT FUFE KYA* FUS SAVAY VA(FEK FAVA*V*C*NI*Y VYAKTI
T*E

PRAD*AA*N MAV*TRI* RA*JI*V GA*H*D*I* KO TO REDIYO FE*R DURADARS*AN
HAR ROJ K*UB FUC*A*LTE HI* HE*V* KYA* FUN KE PARIVA*R KE FANY LOGOV*
KA* B*I* SAKARA*RI GUN*GA*N JARURII* HE

App B

```
C       PROGRAM FREQ
        DIMENSION ITXT(82),LIST(80),KOUNT(80),IERR(80),IJ(3),IOUT(80)
        DIMENSION PROB(80),INDXM(14),INDXV(12),INDXC(54),ICH(80)
        INTEGER OUTT,PAPR,REC
        DATA (LIST(K),K=1,6)/'A','E','H','I','O','U'/
        DATA (LIST(K),K=7,13)/'A','E','I','O','U',':'/
        DATA (LIST(K),K=14,23)/'A','B','C','D','E','G','H','I','J','K'/
        DATA (LIST(K),K=24,33)/'L','M','N','O','P','Q','R','S','T','U'/
        DATA (LIST(K),K=34,43)/'V','W','X','Y','Z',':','(',')','0','1'/
        DATA (LIST(K),K=44,53)/'2','3','4','5','6','7','8','9','!',','/
        DATA (LIST(K),K=54,56)/'.','-','"'/
        DATA (LIST(K),K=57,66)/'A','U','C','D','E','G','H','I','J','K'/
        DATA (LIST(K),K=67,76)/'L','M','N','O','P','Q','R','S','T','U'/
        DATA (LIST(K),K=77,80)/'V','W','X','Z'/
C
        DATA INDXM/14,57,18,61,63,21,64,68,27,70,33,76,77,39/
        DATA INDXV/7,1,8,2,9,4,11,5,12,6,13,10/
        DATA (INDXC(K),K=1,10)/3,15,16,17,19,20,22,23,24,25/
        DATA (INDXC(K),K=11,20)/26,28,29,30,31,32,34,35,36,37/
        DATA (INDXC(K),K=21,30)/38,40,41,42,43,44,45,46,47,48/
        DATA (INDXC(K),K=31,40)/49,50,51,52,53,54,55,56,58,59/
        DATA (INDXC(K),K=41,50)/60,62,65,66,67,69,71,72,73,74/
        DATA (INDXC(K),K=51,54)/75,78,79,80/
C
        DATA (ICH(K),K=1,5)/'A','A*','E','E*','H*'/
        DATA (ICH(K),K=6,10)/'I','I*','M*','O','O*'/
        DATA (ICH(K),K=11,14)/'U','U*','V*',':'/
C
        DATA (ICH(K),K=15,19)/'FA','FA*','FE','FE*','FI'/
        DATA (ICH(K),K=20,24)/'FI*','FO','FO*','FU','FU*'/
        DATA (ICH(K),K=25,26)/'F:','FN'/
C
        DATA (ICH(K),K=27,31)/'FH*','B','C','D','G'/
        DATA (ICH(K),K=32,41)/'H','J','K','L','M','N','P','Q','R','S'/
        DATA (ICH(K),K=42,51)/'T','V','W','X','Y','Z','(',')','0','1'/
        DATA (ICH(K),K=52,61)/'2','3','4','5','6','7','8','9','!',','/
        DATA (ICH(K),K=62,64)/'.','\','"'/
        DATA (ICH(K),K=65,69)/'B*','C*','D*','G*','J*'/
        DATA (ICH(K),K=70,74)/'K*','L*','N*','P*','Q*'/
        DATA (ICH(K),K=75,80)/'R*','S*','T*','W*','X*','Z*'/
        DATA ITXT(81),ITXT(82)/' ',' '/
        DATA IBLNK,IFF,ISTAR/' ','F','*'/
        DATA IAMP,IDOLR/'&','$'/
        DATA (KOUNT(K),K=1,80)/80*0/
        DATA (IERR(K),K=1,80)/80*' '/
        DATA IPLUS/'+'/,(IOUT(K),K=1,80)/80*81/
C
C
        N1=6
        N2=13
        N3=56
        N4=80
        REC=0
C
        OUTT=2
        INT=1
        PAPR=3
C
CCC     READ ACARD
CCC
C
100     CONTINUE
C
CCC     WRITE( 3   ,105) (IERR(K),K=1,80)
C105    FORMAT(5X,80(A1))
C
CWRITE (4,3100) (IOUT(N),N=1,65)
C100    FORMAT(1X,65(I2))
        DO 110 J=1,82
        ITXT(J)=IBLNK
110     CONTINUE
CC
C
        DO 120 J=1,80
        IERR(J)=IBLNK
        IOUT(J)=81
120     CONTINUE
CCC
CCCCC
C
        READ(1,130)(ITXT(K),K=1,80)
130     FORMAT(80A1)
C
CCC     INCREMENT RECORD COUNTER
C
        REC=REC+1
C       THE REC. IS PRINTED ON PAPER
```

```
C
C        WRITE( 3,140) (ITXT(K),K=1,80)
C140     FORMAT(5X,80(A1))
C
C       If it is a comment rec read next rec.
C       (Comment rec have '$' in col 1)
C
        IF(ITXT(1) .EQ. IDOLR) GO TO 100
C
C       IF IT IS END OF INPUT STOP PROCESSING AND PRINT RESULTS ETC.
C       (END OF INPUT IS SIGNIFIED BY '.' IN COL 1 AND ENTRIES AFTER
C         COL 1 ARE NOT PROCESSED.
C
        IF(ITXT(1) .EQ. IAMP) GO TO 142
        GO TO 145
142     IOUT(1)=ITXT(1)
        GO TO 5000
C
C       MAIN PROCESSING BEGINS
C
C
145     KK=0
          J=0
150       J=J+1
        KK=KK+1
        IF(J .GT. 80) GO TO 100
C
C       IF J TH. CH. IS A BLANK PROCESS NEXT CH.
C
        IF(ITXT(J) .EQ. IBLNK) GO TO 160
        GO TO 170
160     IOUT(KK)=99
        GO TO 3000
C
C       TO TEST IF J TH. CH. IS 'F' OR NOT
C
170     IF(ITXT(J) .NE. IFF) GO TO 2000
C
C       TO TEST IF J+2 TH. CH. IS '*' OR NOT
C
        IF (ITXT(J+2) .NE. ISTAR) GO TO 1500
C
C       THE PRESENT SEQUENCE OF CHS. IS :
C         J TH. 'F' ; J+2 TH. '*'
C       SEARCH FOR THE MIDDLE CH. FROM LIST
C
        DO 1000 M=1,N1
        IF (ITXT(J+1) .NE. LIST(M)) GO TO 1000
        KOUNT(M)=KOUNT(M)+1
        IOUT(KK)=M
        GO TO 1200
1000    CONTINUE
        K=J+1
C
        IERR(K)=IPLUS
        IOUT(KK)=98
1200    CONTINUE
        J=J+2
        GO TO 3000
C
C       THE PRESENT SEQUENCE OF CHS. IS :
C         J TH. 'F' ; J+2 TH. NOT A '*'
C       TO TEST FOR CH. AFTER 'F'
C
1500    CONTINUE
        DO 1600 I=N1+1,N2
        IF (ITXT(J+1) .NE. LIST(I)) GO TO 1600
        KOUNT(M)=KOUNT(M)+1
        IOUT(KK)=M
        GO TO 1800
1600    CONTINUE
        K=J+1
C
        IERR(K)=IPLUS
        IOUT(KK)=98
1800    CONTINUE
        J=J+1
        GO TO 3000
C
C       THE SEQUENCE OF CHS. IS :
C       J TH. CH. IS NOT 'F'
C       TO TEST IF J+1 TH. IS '*' OR NOT
C
2000    CONTINUE
        IF(ITXT(J) .NE. ISTAR) GO TO 2070
C
        IERR(J)=IPLUS
        GO TO 3000
```

```
2070      IF(ITXT(J+1) .EQ. ISTAR) GO TO 2500
C
CC        TO FIND THE J TH. CH. WHEN J+1 TH. IS NOT '*'
C
          DO 2100 M=M2+1,M3
          IF(ITXT(J) .NE. LIST(M)) GO TO 2100
          KOUNT(M)=KOUNT(M)+1
          IOUT(KK)=M
          GO TO 2300
2100      CONTINUE
C
          IERR(J)=IPLUS
          IOUT(KK)=98
2300      CONTINUE
          GO TO 3000
C
CC        THE SEQUENCE OF CHS. IS :
CC        J+1 TH. IS '*'
C         TO FIND CH. J FROM LIST
C
2500      CONTINUE
          DO 2600 M=M3+1,M4
          IF(ITXT(J) .NE. LIST(M)) GO TO 2600
          KOUNT(M)=KOUNT(M)+1
          IOUT(KK)=M
          GO TO 2800
2600      CONTINUE
C
          IERR(J)=IPLUS
          IOUT(KK)=98
2800      CONTINUE
          J=J+1
          GO TO 3000
C
C
3000      CONTINUE
C
CC
C100      FORMAT(40(I2))
CWRITE(4,3100) (IOUT(N),N=41,80)
C
          GO TO 150
C
CC
CC        PROCESSING OVER ( LAST REC. FOUND )
C         THE RESULTS ARE PRINTED
C
5000      CONTINUE
C
CWRITE(4,3100) (IOUT(N),N=1,40)
CWRITE(4,3100) (IOUT(N),N=41,80)
          TOTAL=0.0
          DO 7000 I=1,80
          TOTAL=TOTAL+KOUNT(I)
7000      CONTINUE
          DO 7500 I=1,80
          PROB(I)=KOUNT(I)/TOTAL
7500      CONTINUE
C
C
          WRITE(3,8000)
8000      FORMAT(5X,'SYMBOL',10X,'OCCUR',10X,'PROB'/)
          WRITE(3,8100)
8100      FORMAT(5X,'DATRA'/)
C
C
          DO 8500 I=1,14
          J=INDXM(I)
          WRITE(3,8200) ICH(I),KOUNT(J),PROB(J)
8200      FORMAT(5X,A4,12X,I8,7X,F10.5/)
8500      CONTINUE
C
C
          WRITE(3,8600)
8600      FORMAT(15X,'VOWEL'/)
C
          DO 9000 I=15,26
          J=INDXV(I-14)
          WRITE(3,8200) ICH(I),KOUNT(J),PROB(J)
9000      CONTINUE
C
C
          WRITE(3,9100)
9100      FORMAT(/,5X,'CONSONANTS',/)
C
C
          DO 9300 I=27,80
          J=INDXC(I-26)
          WRITE(3,8200) ICH(I),KOUNT(J),PROB(J)
```

```
9300     CONTINUE
C
C
C
         WRITE(3,8400) TOTAL_REC
8400     FORMAT(5X,'TOTAL OCCUR. 'F10.0,10X,'TOTAL REC. ',I8)
C
C
         STOP
         END
```

App-D

SYMBOL	OCCUR	PROB
MATRA		
A	5953	0.11622
A*	4007	0.07823
E	2906	0.05673
E*	634	0.01238
H*	65	0.00127
I	1872	0.03655
I*	1927	0.03762
M*	18	0.00035
O	1293	0.02524
O*	72	0.00141
U	706	0.01378
U*	299	0.00584
V*	1583	0.03090
:	16	0.00031
VOWEL		
FA	358	0.00699
FA*	326	0.00636
FE	263	0.00513
FE*	26	0.00051
FI	260	0.00508
FI*	136	0.00266
FO	69	0.00135
FO*	182	0.00355
FU	339	0.00662
FU*	10	0.00020
F:	0	0.00000
FN	2	0.00004
CONSONANTS		
FH*	12	0.00023
H	782	0.01527
C	425	0.00830
D	1044	0.02038
G	781	0.01525
Y	1839	0.03590
J	795	0.01552
K	3079	0.06011
L	1330	0.02596
M	1621	0.03165
N	2065	0.04031
P	1177	0.02298
Q	101	0.00197

S	1863	0.03637
T	1644	0.03209
V	950	0.01855
W	59	0.00115
X	158	0.00308
Y	1331	0.02598
Z	85	0.00166
(	29	0.00057
)	29	0.00057
0	37	0.00072
1	69	0.00135
2	47	0.00092
3	22	0.00043
4	17	0.00033
5	24	0.00047
6	12	0.00023
7	10	0.00020
8	17	0.00033
9	10	0.00020
!	15	0.00029
,	197	0.00385
.	722	0.01409
\	76	0.00148
"	83	0.00162
B*	397	0.00775
C*	137	0.00267
D*	225	0.00439
G*	89	0.00174
J*	48	0.00094
K*	272	0.00531
L*	26	0.00051
M*	55	0.00107
P*	198	0.00387
Q*	72	0.00141
R*	196	0.00383
S*	330	0.00644
I*	318	0.00621
W*	21	0.00041
X*	54	0.00105
Z*	20	0.00039
TOTAL OCCUR.	51224.	TOTAL REC. 1464

App-E

```
      PROGRAM DIGM
      DIMENSION LIST(81),IREC(80),KOUNT(81,81)
C
      DATA(LIST(K),K=1,5)/'FA*','FE*','FH*','FI*','FO*'/
      DATA (LIST(K),K=6,10)/'FU*','FA','FE','FI','FO'/
      DATA (LIST(K),K=11,15)/'EO','FU','E','A','B'/
      DATA (LIST(K),K=16,20)/'C','L','E','G','H'/
      DATA (LIST(K),K=21,25)/'I','J','K','L','M'/
      DATA (LIST(K),K=26,30)/'N','O','P','Q','R'/
      DATA (LIST(K),K=31,35)/'S','T','U','V','W'/
      DATA (LIST(K),K=36,40)/'X','Y','Z',':','('/
      DATA (LIST(K),K=41,45)/')','0','1','2','3'/
      DATA (LIST(K),K=46,50)/'4','5','6','7','8'/
      DATA (LIST(K),K=51,55)/'9','!','.',',','-'/
      DATA (LIST(K),K=56,60)/'"','A*','B*','C*','D*'/
      DATA (LIST(K),K=61,65)/'E*','G*','H*','I*','J*'/
      DATA (LIST(K),K=66,70)/'K*','L*','M*','N*','O*'/
      DATA (LIST(K),K=71,75)/'P*','Q*','R*','S*','T*'/
      DATA (LIST(K),K=76,80)/'U*','V*','W*','X*','Z*'/
      DATA LIST(81)/'81'/
C
      DATA IAMP/'&'/
      DATA ((KOUNT(I,J),I=1,81),J=1,81) /6561*0/
      IREC(64)=53
      IT=0

C
      DO 5000 JIJ=1,500
      KKK=IREC(64)
      READ(1,100) (IREC(K),K=1,64)
100   FORMAT(1X,64I2)
      IF(IREC(1).EQ.IAMP) GO TO 5000
      IF(KKK.EQ.53)GO TO 150
      IF(IREC(1).EQ.53) GO TO 150
      I=KKK
      J=IREC(1)
      KOUNT(I,J)=KOUNT(I,J)+1
150   I1=IT+1
      DO 200 N=1,63
      IF(IREC(N).EQ.53) GO TO 200
      IF(IREC(N+1).EQ.53) GO TO 200
      IF(IREC(N).EQ.0) GO TO 200
      IF (IREC(N).GT.81) GOTO 200
      IF (IREC(N+1).GT.81) GOTO 200
      I=IREC(N)
      J=IREC(N+1)
      KOUNT(I,J)=KOUNT(I,J)+1
      IT=IT+1
200   CONTINUE
C
CC    GO TO 50
C
C
5000  CONTINUE
      WRITE(3,300)
300   FORMAT(1H1)
      WRITE(3,350) (LIST(K),K=1,20)
350   FORMAT(3X,4X,2X,20(A4,2X))
      DO 500 J=1,81
      WRITE(3,550) LIST(J),((KOUNT(J,N),N=1,20))
550   FORMAT(1X,A4,2X,20(I4,2X))
500   CONTINUE
      WRITE(3,300)
      WRITE(3,350)(LIST(K),K=21,40)
      DO 600 J=1,81
      WRITE(3,550) LIST(J),((KOUNT(J,N),N=21,40))
600   CONTINUE
      WRITE(3,300)
      WRITE(3,350) (LIST(K),K=41,60)
      DO 700 J=1,81
      WRITE(3,550) LIST(J),((KOUNT(J,N),N=41,60))
700   CONTINUE
      WRITE(3,300)
      WRITE(3,350) (LIST(K),K=61,80)
      DO 800 J=1,81
      WRITE(3,550) LIST(J),((KOUNT(J,N),N=61,80))
800   CONTINUE
C
C     WRITE FOR IT
      WRITE(3,*) IT,TT,IT,IT
      STOP
      END
```

App-F

```
PROGRAM COUNT(DATA,BUFFER,RESULT,OUTPUT);
VAR
 W:ARRAY [1..6000,1..20] OF CHAR;
 CH:CHAR;
 I,K,KK,L,JJ:INTEGER;
 NUM_OCC:ARRAY [1..6000] OF INTEGER;
 CL:ARRAY [1..6000] OF INTEGER;
 DATA,BUFFER,RESULT:TEXT;

PROCEDURE INP;
VAR      K1,L1:INTEGER;

 BEGIN                    K1:=0;
       WHILE (NOT(EOLN(BUFFER))) DO
   BEGI
       K1:=K1+1;
       READ(BUFFER,W[I,K1])
   END;
       FOR L1:=(K1+1) TO 16 DO
     BEGIN
       W[I,L1]:=' '
     END
 END;

PROCEDURE OUT(K1:INTEGER);
VAR      L1:INTEGER;

 BEGIN
       FOR L1:=1 TO 16 DO
   BEGI
       WRITE(RESULT,W[K1,L1]:1)
   END
END;

FUNCTION COMP(I1,K1,JJ1:INTEGER):BOOLEAN;
VAR           L1:INTEGER;      C:BOOLEAN;
BEGIN
       IF CL[I1] <>  CL[K1] THEN C:=FALSE
       ELSE

   BEGIN
     C:=TRUE ;

       FOR L1:=1 TO JJ1 DO
BEGIN
       IF W[I1,L1]<>W[K1,L1] THEN
      BEGIN
             C:=FALSE
        END
END;
END;
       IF (C=FALSE) THEN
       COMP:=FALSE
      ELSE
       COMP:=TRUE
END;

BEGIN
 I:=0;CH:='L';KK:=0;
 RESET(DATA);

WHILE (NOT(EOF(DATA))) DO
 BEGIN
 IF (I<>0) THEN READLN(DATA);

 WHILE (NOT(EOLN(DATA))) DO
  BEGIN          {WHILE EOL
  READ(DATA,CH);

 JJ:=0;
  REPEAT
   READ(DATA,CH);       JJ:=JJ+1;

   IF (CH<>' ') THEN WRITE(BUFFER,CH:1)
  UNTIL CH=' ';

  RESET(BUFFER);
  IF (NOT(EOF(BUFFER))) THEN

   BEGIN
    I:=I+1;CL[I]:=JJ;KK:=KK+1;
    INP;
    K:=0;
    REPEAT
     K:=K+1;
     UNTIL (COMP(I,K,JJ)) OR (K=I);
    IF (K<=(I-1)) THEN
     BEGIN
      NUM_OCC[K]:=NUM_OCC[K]+1;
```

```
      I:=I-1 ;
     END
     ELSE
     BEGIN        NUM_OCC[K]:=1;END
    END

  END             { eoln while
 END;             { eof while
 REWRITE(RESULT);
BEGIN
 I:=(I+3)DIV 4;
END;
 WRITELN(RESULT,'TOTAL NO OF WORDS=',KK);
 FOR L:=1 TO I DO
  BEGIN
   OUT(4*L-3);
   WRITE(RESULT,NUM_OCC[4*L-3],'  ');
   OUT(4*L-2);
   WRITE(RESULT,NUM_OCC[4*L-2],'  ');
   OUT(4*L-1);
   WRITE(RESULT,NUM_OCC[4*L-1],'  ');
   OUT(4*L);
   WRITELN(RESULT,NUM_OCC[4*L],' ');
{    WRITELN('"',W[L],'" occurs',NUM_OCC[L],' times.')}
 END
END.
```

4201

```
    0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0
    0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0
    0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0
    0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0
    0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0
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App-6

Programm made by AVNEESH GUPTA Department of physics Aligarh Muslim University

TOTAL NO OF WORDS= 12610

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PAHALE	19	SE	224	SA*FIN	4	KT*	260
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VIS*EOAKAR	1	FUS	29	SAMAY	29	XA*P	1
HI*ROFINOV*	1	S*ARMILA*	1	FO*R	183	MUMATA*J	1
SAMMALIT	1	HONE	24	FA*D*A*R	3	PAR	114
PRADARS*AN	3	PES*	4	KIYA*	44	HI*	63
JA**A*	9	T*A*	63	FISALIFE	3	RA*JES*	2
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GAYA*	70	P*IR	14	DO	19	RA*STE	1
TI*SARI*	1	MILAN	4	BAR*I*	8	RASSA*KAS*I*	1
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SIRP*	1	BALKI	2	SUPAR	2	SIDD*	1
PARIN*A*MA	1	SVARUP	1	FITANI*	4	P*ILME	1
VIL	9	GAFI*	11	KUC*	37	P*ILMO	1
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SAKATI*	8	FA*P	16	KALPANA*	1	SAKATE	6
HE*V*	81	FAGAR	7	B*I*	109	P*LA*P	1
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HE*	298	NIRMA*TA*	2	GAR*	1	FAB	18
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KA*MAYA*BI*	1	P*ILMO*	1	FA*P*ARJ	1	SE*LA*B	1
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BAH	1	JA*TA*	14	JO	43	FACC*A*	5
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NE	130	KAM	8	BABBAR	1	KO	209
X*V*WE	1	DIL	3	SOCANE	2	FAG*ORI*	2
FUNAKA*	3	PI*C*A*	1	KARATA*	7	BASTI*	3
VA*LE	15	DINOV*	9	BA*RE	14	P*E*SALA*	1
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BALA*	1	NA*JIL	1	HAMA*RI*	6	MADAD	3
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GAM	1	FUX*A*NE	1	PAR*E	2	NASI*B	1
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FAPANI*	28	BEXI*	1	SO*V*PA*	1	KADAMOV*	1
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S*ARA*B	2	PI*NE	1	S*IO*AKOV*	3	JFL	2
B*IVA*NI*	1	HARIYA*N*A*	1	MUK*Y	7	SAV*SADJ*Y	1
SACIV	8	FH*I*	10	CETA*VANI*	3	DT*	41
DVA*RA*	32	FAD*YA*PAN	1	DO*RA*N	8	PIYE	1
JA*NE	16	FUNHEV*	7	BARK*A*ST	1	NAHI*	7
JA*YEGA*	7	PAR*EGA*	2	BATA*YA*	5	SKU*LO*	1
C*A*PA*	2	MA*RANE	1	LIYE	36	VIS*EO	3
DAL	4	BANA*YE	2	GAVE	1	TA*KI	2
BURA*FI*	1	JA*	22	SAKE	6	8	14
KILO	2	FAP*I*M	2	BARA*MAD	4	FUJJE*N	1
KENDRI*Y	4	NA*RAKOTIKS	1	VIB*A*G	5	MAV*DASO*R	1
JILE	3	BASAFI*	1	GRA*M	5	VYAKTIYO	4
GIRAP*TA*R	1	FUNAKE	10	KABJE	2	LAGAB*AG	3
LA*K*	2	RUPAYE	8	MU*LY	2	FAVE*D*	3
JABT	1	LI*	10	SU*ZO	1	FANUSAR	1
MA*MALA*	2	PULIS	45	SO*P	1	SVATAV*ZATA*	3
SENA*NI*	2	NID*AN	2	XIHARI*	2	JANAPAD	3
VAYOVH*DD*	1	KH*ON*A*NAND	1	PE*NYU*LI*	2	LAMBI*	1
BI*MA*RI*	3	FAPANE	18	NIVA*S	1	ST*A*N	2

VAH	60	VARQ	10	PARIVA*R	4	B*U*TAPU*RV	7
SAV*SAD	1	SADASY	3	PARI	1	PU*RN*ANND	1
SAHIT	1	TI*N	12	PUZ	1	PUZIYA*	1
VA	19	PATNI*	9	PUTPA*DAN	4	YOJANA*	6
GUR*AGA*V*V	2	PUPA*YUKT	1	B*AGAVATI*	1	PRASA*D	2
YAHA*V*	17	VARQI*Y	1	VID*IVAT	1	VIMOCAN	1
SIV*DI*	1	KE*	1	BE*V*K	2	UIS	4
LI*W	1	TE*YA*	1	GAYI*	50	RUPAYA*	1
K*ARC	3	HOGA*	16	TAT*A	1	MA*RC	14
98	5	HAJA*R	7	GARI*B	1	MAD*YAM	2
VARG	2	LA*B*ANVIT	1	HOGE	1	PRAMUK*	3
FUDDES*Y	2	PARIVA*RO	1	KH*QI	1	BAJA*Y	1
FUDYOG	1	VYA*PA*R	2	FAPANA*NE	1	JOR	7
DENA*	8	S*EK*	3	FABDULLA*	2	FH*I*NAGAR	1
PRASIDD*	2	P*LIM	1	NIRDES*AK	1	FINDER	1
NA*YAR	1	KAS*MI*R	2	SVA	1	MUK*YMAV*ZI*	3
JI*VAN	5	RAV*GI*N	2	P*I*CAR	1	BANA*YEV*GE	1
JISAKI*	2	S*U*XIV*G	1	HOGI*	5	K*A*LASA*	1
SKU*L	5	RAKES*	1	RA*MAPA*L	1	VE	19
MINAX	3	ME	27	GOL	3	TI*M	13
VIJAY	5	DILA*YI*	1	JABALPUR	1	RA*OXRI*Y	2
JU*NIYAR	1	HA*KI*	5	SPARD*A*	1	7	13
JANVARI*	1	S*URU	4	FUSAME	1	XIM*E	1
B*A*G	5	LEV*GI*	1	MAD*YA	1	PRADES*	3
SAG*	1	MA*NAD	1	FEM	8	FEL	4
GAV*B*I*R	3	FIN	16	XI*MO	2	FA*X*	4
SAMU*HOV*	1	BAXV*XA*	1	GAYA	4	FEVAV*	2
DRA*	1	NIKA*L	1	GAYE	26	PRATIYOGITA	2
LI*G	7	NA*KAFA*FUX	1	PADD*ATI	1	K*ELI*	3
JA*YEGI*	3	HAR	11	SAMU*H	1	VIJETA*	1
FAV*KO	1	FA*D*AR	1	KVA*XAR	1	P*A*FINAL	10
MAD*YA*VAKA*S*	1	BAL*AT	2	LEKAR	7	SENA*	1
JAVA*NO	1	JI*T	10	NIS*CIT	3	SI*D*E	6
KVA*RXAR	1	P*A*	1	FINAL	1	PRAVIQX	1
FANY	7	VIDES*I*	9	XI*M	6	FUJABEKISTA*N	1
FEKA*DAS*	1	SOVIYAT	1	SAV*G*	2	PAHALA*	3
KADAM	1	SUK*AD	1	FACC*E	2	K*EL	7
BA*RAJU*D	1	RUSI*	1	FI*	3	JA*LAND*AR	2
PIX	1	PU*L	1	ME*C	17	PAV*JA*B	32
S*AKTIS*ALI*	1	SI*MA*	4	SURAQ*A*	5	BAL	4
RAHIT	1	BARA*BAR	1	RAH	3	FAV*K	1
BA*V*X	1	MEHAMA*N	2	C*AKA*YE	1	RAK*A*	4
HA*LE*V*W	2	GOLOV*	1	BO*C*A*R	1	SILASILA*	1
HUFA*	23	DU*SARE	9	PENALXI*	1	KA*RNAR	1
SEV*XAR	1	P*RAVARN	1	TIRAKE	1	LEP*X	2
FA*FUX	1	MEV*GARA*	1	K*A*TA*	1	K*OLA*	1
FUTSA*HIT	1	TAK*TA*	1	K*AR*AKA*	1	RA*FIX	1
SI*	7	LAKARA*	2	BAL*A*FI*	1	GEV*D	5
VI*	7	FA*GE	7	BAL*	4	FA*YE	5
GOLI*	12	CAKAMA*	1	DEKAR	2	B*ED	1
DU*SARI*	2	SAP*ALATA*	2	YA*ZA*	2	KA*P*I*	7
MAHATV	1	B*A*RATI*Y	11	KRIKET	8	KAN*TROL	1
BORN	4	JANAVARI*	10	DILLI*	4	FA*	11
JABAKI	7	FAD*YAJ*	11	RA*J*D*A*NI*	1	FOR	11
HA*L	6	GA*YAKAVA*R*	1	FAMPA*YARIV*G	1	STAR	2
S*IKA*YAT	1	JISAKE	2	PA*KISTA*NI*	1	FEYAR	1
MA*RS*AL	1	NU*R	1	K*A*M*	2	KAPTA*NO	1
PA*LI*	1	FUMARI*GAR	1	MAV*SU*R	1	FALI*	3
PAXO*DI*	1	FA*MANZIT	2	FATIT*I	1	RUP	3
PA*KISTA*N	2	TAT*A*	31	S*EO	1	ME*CO	1
PREO*AK	1	BA*XE	1	LAR*AKIYO	1	MI*TA*	1
SINHA*	1	RA*Y	3	JYOTI	2	MEHATA*	1
GEMO	1	HARA*YA*	1	LAR*AKO	1	FASAM	1
FARUR*	1	BARUFA*	1	KA*NAPUR	1	SAV*JI*V	1
PA*X*XAK	1	HARA*	1	LIYA*	14	MIFH*IT	1
YUGAL	1	K*ITA*B	1	JI*TANE	1	GO*RAV	1
FIN*NIYAN	1	FEYARALA*FINS	1	JOR*I*	1	KAS*AMI*RA*	1
PAXEL	2	RAJAT	1	MILA	1	JINHONE	1
MAHA*RA*OXR	2	NIS*IT	1	VYA*S	1	NIYATI	1
WISKO	1	XI*	1	KEVAL	7	T*OR*E	1
PU*RN*AT	1	FA*YA*TIT	1	KIX	1	BANE	1
SEX	1	PU*RN*ATAYA*	1	SA*LIW	1	SXEX	1
BLE*K	1	SXRA*	1	FIP	1	PIKCAR	1
XYU*B	1	SADASYOV*	2	CINTA*	2	SVA*B*AVIK	1
PARAMA*N*U	5	PRODYOGIKI*	2	JITANI*	1	FAD*IK	5
SAMB*A*VANA*FEV*	2	FUTANI*	1	FUSME	1	D*O*V*SAPAXXI*	1
GUV*	1	JAYAS*	1	SAMPANN	3	RA*OXR	2
MAHA*VINA*S*AK	1	HAT*IYA*RO*V*	1	VIKA*S	3	VIS*V	15
MAHA*VINA*S*	1	NIKAX	2	B*AVIOY	2	FU*RJA*	3
VIKALP	1	DIK*A*FI*	1	DETA*	4	SO*B*A*GY	2
HAMA*RE	9	DES*	6	KACCE	1	FI*V*D*AN	1
KAMI*	1	VIZ*A*N	1	RA*JYAMAV*ZI*	1	CANDR	1
PRATA*P	1	NA*RA*YAN*	1	LOKASAB*A*	2	JA*NAKA*RI*	1
FANUSA*R	7	C*A*ZA*FO	2	MA*ZA*	2	B*OJAN	2
MILATA*	3	FUNHE	1	PARYA*PT	1	DU*QIT	1

P*ALASVARUP	1	FAD*IKA*V*S*	2	SVA*ST*Y	1	K*ARA*B	1
RAHATA*	7	YE	8	C*A*ZA*FEV	1	NIRD*AN	1
SAMA*J	5	KAMAJOR	1	VARGO	1	PA*LIKA*	1
G*OQIT	1	KIFE	1	PAS*CA*T	1	NAGARI*Y	1
SAMASYA*	4	FO	4	PRATI	2	FUPEQ*A*	1
RAN*	1	FESE	3	MAHA*NARAKAPA*LI	1	SAV*Z*A*	1
JA*FE	2	PATIS*AYOKTI	1	JANATA*	5	FAPAND*	1
SAMASYAFEV*	1	SAMA*CAR	1	PAZO	2	MAV*G	2
FEVV*	8	Z*A*PANO	1	DE	8	HA*R	17
PARANTU	1	SUNAVA*FI*	1	SA*RA*	2	NAGAR	2
FUGA*FI*	1	PE*SA*	3	SARAKA*R	8	RAHT*	18
FESI*	1	HA*LAT	3	KISA*N	4	KAH	4
GANNE	1	KISA*NO	1	S*I*	1	G*RA	1
PE*SE	1	B*UGATA*N	2	KARAVA*FE	1	BA*BU*RA*M	1
FAGRAVA*L	1	BA*GAPAT	1	MURA*DA*BA*D	1	RELAVE	3
BINA*	5	LA*FISEV*S	1	DUKA*NE	1	K*OL	3
RAK*I*	2	FISASE	7	VE*D*	1	LA*FISEV*SAD*A*R	1
HA*NI	1	FUX*A*NI*	2	PAR*ATI*	1	DUKA*NADA*RO	1
J*AGAR*E	1	B*AY	1	BANA*	1	DVA*R	2
DI*VA*R	2	TOR*	3	FA*V*DOLAN	2	JA*RI*	1
RAHEGA*	3	NES*ANAL	2	YU*NIYAN	1	FA*P*	5
JARNALISX	2	KAPIL	1	VARMA*	1	MATAB*ED	1
PE*DA*	5	FA*ROP	1	LAGA*TE	1	HUFE	22
NO*	4	SAV*GAX*ANO	2	PA*V*C	8	BA*TACI*T	2
BULA*YA*	1	FINAME	1	YUNIYAN	1	F	1
NAFI*	5	MUK*	1	YAMAV*ZI*	1	SA*HEB	1
B*OV*SALE	1	HAXA*NE	1	PA*JY	4	FASUV*TUQX	1
KA*V*GRESAJANO	1	NAFE	2	SIRE	2	FAB*IYA*N	1
CALA*VE	1	G*OQAN*A*	1	KA*V*GRES	4	FUCCAKAMA*N	1
DEK*A*	9	JA*NAKA*RD*	1	KA*XEK	1	NAQ*AZ	2
VE*	1	Z*A*	1	NIKO	1	SA*N	1
WIFEGO	1	PA*LOMA*R	1	PARVAT	1	FIV*C	1
FA*KA*R	1	VIS*A*L	1	DU*RABI*N	1	SA*L	6
K*OJARI*N	1	VE*Z*A*NIK	2	FEWAVARW	1	WENIYALASAN	1
SNA*TAK	1	C*A*Z	1	WEVIV	1	JEVIX	1
S*UKRAVA*R	1	RA*T	10	PUCC*AL	1	KA*L	8
PATA*	8	LAGA*YA*	1	FART*A	1	VYAVAST*A*	1
SAV*KA*	1	BACA*NE	1	VIKA*	1	VIKA*SAS*I*L	1
DES*OV*	1	FUDA*RATA*PU*RVA	1	FA*RT*IK	2	SAHA*YATA*	3
DIYE	5	FA*HVA*N	1	MUK*ARJI*	1	KAL	9
YAHA*	1	SAV*YUKT	2	SAMMELAN	4	FNKAXA*W	1
GOOX*I*	1	FUDG*A*XAN	2	KARATE	8	HUYE	7
BIGAR*ATI*	1	NIRA*FI*	2	KARO	2	ME*V*	35
TUMHE	1	BATA*FU*V*GA*	1	KAHATE	3	WA*KIYA*	1
KYA*RIYU	3	FUG	1	FA*FI*	8	G*A*S	2
FUK*A*R*ANE	2	LAGA*	16	SONU*	1	FUSAKE	21
SA*T*	20	SAB	7	WA*KIFE	1	FA*FO	1
KINA*RE	3	LAGI*	6	XEL*I*MEL*I*	1	FI*XO	1
X*I*K	4	SUHA*S	2	B*U*L	2	B*A*N	1
MAKA*N	10	NAV*HAR	1	YAD	1	LFNA*	2
FE*SE	9	KAB	1	B*AXAKATA*	1	G*U*MANE	1
T*AKANE	1	TAB*I*	2	DU*R	3	DIK*AFI*	2
FA*V*GAN	4	RAV*GABIRAV*GE	1	BALRO	1	ROS*ANI*	1
JAGAMAGA*	1	PAHUV*C	3	FUSNE	4	VAHAYV*	1
BACCF	5	JAMA*	1	BI*C	8	MFJ	1
KEK	1	SAJA*	4	SOCA*	5	YAHI*	8
RAV*JANAJI*	1	YAHI*V*	2	MAV*	1	HOV*GI*	2
KAMA*L	1	TUM	4	JA*NATI*	2	ME*	8
SAV*B*A*LE	1	HU*V*	12	JIS	4	C*AT	2
SI*R	1	GIRE	2	G*AMAV*WI*	1	C*IPAKALI*	2
FUTTAR	3	FUSI*	5	FUD*AR	4	MURAGA*	1
GUJARA*	1	MAKK*I*	1	GARAMA*GARAM	1	BAHAS	1
SUN	1	S*A*MIL	11	ROTE	1	HAV*SA*YA*	1
BA*R	18	HAME	1	HAV*S	2	DIK*A*FO	1
KAH*I	2	PA*PA*	1	JALDI*	4	P*URASAT	1
PA*	7	KAB*I*	11	DAP*TAR	2	KA*M	23
CIR*IYA*G*AR	1	DIK*A*	1	LA*FO	1	GAJARA*J	2
HA*T*I*	2	FIKALO*TE	1	BEXE	1	RA*JU*	5
PYA*R	1	T*AY	1	S*AHAR	3	SA*MA*N	2
LA*TA*	1	CA*BI*	1	VA*LI*	7	MOXAR	2
BOLANE	1	GUR*IYA*	1	C*OXI*	1	SU*V*W	1
K*ILO*NE	1	FUX*A*YE	1	PU*RE	4	CAV*PAKAVAN	1
G*U*MATA*	1	LA*YA*	2	K*ELANE	2	BAR*A*	1
MAJA	1	FA*TA*	2	VAN	2	FENY	1
JA*NAVAR	1	JA*TE	7	BI*TATE	1	GAFE	1
PATAJ*AR*	1	MO*SAM	1	FA*YA*	4	FACA*NAK	1
B*A*RI*	2	BARASA*T	1	NA*LOVA	1	BA*L*	1
PA*NI*	7	FUP*AN	1	BAHANE	1	K*ETO	1
B*AR	3	BI*MA*R	1	K*U*B	1	TEJ	3
BUK*A*R	1	MURAGIYOV*	1	DEK*AR*A*L	1	VA*LA*	7
NAT*A*	1	MURAGIYA*V*	1	WAR	1	FONHOV*NE	1
FU*V*CE	1	XI*LOV*	1	S*ARAN*	1	LE	9
BARASATA*	1	TEJI*	2	BAL*ATA*	1	CI*KU*	1
XIV*KU*	1	DA*L	4	KA*LA*	1	NAJAR	5
FUNHOV*NE	21	FASALIYAT	2	LAGA*NE	2	BANA*FI*	2

FUN	12	JA*N	4	K*ATARE	1	PAR*	2
YADI	1	KA*LU*	1	B*ER*IFE	1	PARDA*P*A*S*	1
KITANI*	2	CALI*	2	JA*FEV*GI*	1	DONOV*	16
FAPANI	1	WAMAWAM	1	B*A*LU*	2	BAV*XI*	1
BAV*DAR	1	CUPACA*P	1	SOCA	1	MIYA*V*	1
KAVITA*	1	B*ALA*	3	SAMAJ*EGA*	1	MERI*	10
MIZ	2	NA*RAWA*	1	KARAMA*	1	MILO	1
LOG	14	JANA*WU*	1	LEK*	3	LIK*ANA*	2
CA*HATE	4	PRAYOGS*A*LA*	1	KISALIYE	1	FOH	1
CA*Y	1	MAV*GA*YEV*	1	NAHI*V*SAMAJ*A*	1	FUP*	3
SAVA*L	3	HAM*	1	FA*PANE	2	PAHALI*	3
HAMANE	2	NOKS	1	KILE	1	SONE	2
CORI*	2	SILASILE	1	FISAKA*	2	NA*M	12
SUNA*	2	LESAR	1	KIRAN*OV*	1	FISANE	2
SURAV*G	1	POS*A*K	2	MI*L	2	G*AV*XE	4
RAP*TA*R	1	CAXXA*N	1	KAXATA*	1	BAL*A*	1
JE*SE	8	TE*R	1	PAZ	4	MILA*	6
RA*JA*	5	S*A*HI*	1	MA*D*IK	2	CURA*	1
FU*M*GA*	1	PAHANE	1	PAHARE	1	PAHUV*CA*	1
LUXERA*	1	G*OR*A*	2	FINHONE	1	CI*P*	1
DUHARA*	1	SAMMOHINI*	1	PRAD*EPAN*	1	JA*GO	1
HAMEV*	7	TUMHA*RI*	1	VIS*VA*S	3	XIK	1
KA*X*I*	1	LAGE	4	LA*FUWASPI*KAR	1	BOLATE	1
T	1	TUMHA*RA*	1	TUMHA*RE	1	FA*DES*	3
PISTO*L	1	NIS*A*NA*	1	SA*D*ATA*	1	BILKUL	5
DEK*ATA*	2	HUV*	1	KE*SA*	1	LAGATA*	2
PER*	2	BE*X*ANA*	1	NI*CE	2	D*AR*AM	1
FAD*IKA*RI*	2	GOLIYAT*	1	SAMA*ROH	2	SI*L*I*	1
GIR	4	HOV*GE	3	BA*N*WA*R	1	FA*PAKO	4
SURAQ*IT	1	BI*HAR*	1	JA*YAV*GE	1	BA*BA*BU*	2
JANARAL	3	S*IVIR	1	VETA*L	1	BA*J	1
P*RA*	1	FUR*	2	CALA*	4	K*OPAR*I*NUMA*	1
GUP*A*	1	PAHUM*CA*	1	LA*YE	4	P*RA*KA*	1
K*ABAR	2	MILANA*	1	CA*HATA*	4	LUFA*GA*	3
WA*YANA*	1	SANDES*	2	MAHA*MAHIM	1	FA*PASE	1
SAMPARK	3	NAHIV*	4	SAKEGA*	1	MERE	13
VIMA*N	1	CA*LAK	2	KE*PXEN	2	LOGU*	2
BULA*FO	1	FA*PAKE	4	S*A*NT	1	RA*QXRAPATI	2
SABAKUC	1	NIYANZAN*	1	MURDA*	4	YA*	18
JINDA*	2	LA*HE	2	JINDA	1	BEHATAR	1
XIV*G	1	FOP*	1	XELIP*ON	1	JARURI*NA	1
DEK*E	3	KAMA*N*WAR	1	FA*VA*J	2	PAHACA*N	1
KARNAL	2	VOROBU*	1	SA*HAB	3	JA*SU*SI*	1
KARANI*	1	HA*V*	4	SUBAH	6	NIJI*	1
CUPCA*P	3	BATA*	4	KAHA*M*	1	BATA*TE	1
HA*N*	1	K*A*S	1	JAV*GAL	2	GAS*TI*DAL	1
SADAR	1	MUKA*M	1	JAHARI*LA*	1	KUFA*M*	1
RAHEV*	1	GAS*TI*	1	FA*DES*A*NUSA*R	1	S*ERA*	1
TU*P*A*'	1	X*AHARANA*	1	DARAVA*JA*	1	K*OLO	1
B*ARF	4	DU*KA*N	1	JAGA*NA*	1	FARE	1
E	1	KI*R*A*	1	TEV*DU*	1	PATTOV*	1
JI*VIKO	1	PA*RJAN	1	PARIVA*ROV*	1	BEKA*R	2
K*ATARA*	1	FUTPAUN	1	FA*YOJIT	3	FAK*IL	5
XRA*V*SAPURX	2	FUDAG*A*XAN	1	KAHA*KI	1	CA*LAKOV*	1
B*ALI*	1	B*A*V*TI	2	FAVAGAT	1	FUSAKO	1
HAL	2	PRAYA*S	2	BAKA*YA*	1	FERIYAR	1
KARA*YEV*	1	S*RI*	3	K*A*N	1	DUK*	1
TYO*HA*RO*V*	1	FAVASAR	1	VETAN	3	RIJALT*G*AR	1
FUTTEJIT	1	B*I*P*	2	LAGA	1	B*AG	4
FA*DAMI*	2	FISAMEV*	2	SAMMILIT	2	KARMACA*RIYOV*	3
FAPRIY	7	VYAVAHA*R	3	KA*RYA*LAY	1	TOR*AP*OR*	1
FAXE*CI*	2	V	1	SAMA*CA*R	4	K*A*LT*	1
MILI*	8	BAM	6	KAREV*GE	2	KYOKI	2
KAR*I*	1	MEHANAT	1	PARIN*A*M	1	NJRB*AR	1
KAREGA*	1	K*ULA*	1	VIVARAN*	2	KA*RY	8
FANUB*AV	1	DETE	4	S*I*G*R	2	FA*VEDAN	2
P*A*FINENS	1	KAMPANIYA*V*	1	KARANA*	7	CA*HATI*	5
FAPANA	1	PU*RN*	1	FAR*I*	5	VAL	2
RA*ZI	2	PA*AS*A*	2	MV	2	JA*NTE	2
HOGV*	2	KULPATI*	2	FUPLABD*I*	2	VANCIT	2
RAK*NA*	3	CA*HIE*	2	JOKI	2	FINVIGI	2
LETR	2	VIHI*N	2	B*ALE	4	EK	5
SAV*KALP	2	PAIQUAD	2	FAV*TARGAT	2	BE*X*EGEV*	2
FA*GARA*	4	VIS*VAVIDDA*YALA	2	FAPNE	4	PARI*O*AKOV*	2
TI*FE	2	DI*FE	2	PA*RIH*MIK	2	DENE	5
NHI*V*	2	V*D*E*R	2	KARTI*YAH	2	DER	2
V*D*R	2	VITTI*Y	2	A*B*AV	2	KA*RN*	2
BATLA*YI*	2	JA*T*	2	HO*	2	NO*TIK	2
JIMME*DARI*	2	TI*	4	JISKA*	3	NIRVA*H	2
KATRE*	2	UNHEV*	2	PUN	5	PADGRHAN	2
KARNA*	2	PAR*A*KA*VGRS	2	FI	4	NETA*FOU*	2
TT*	2	SART*K	2	PAZIKA*OV*	2	NE*	2
KA*RE*Y	1	SARA*HNA*	2	KARNE	5	BAJA*YE	2
FUNKI*	2	FA*LOCNA*	2	KARNI*	3	FUCIT	4
SAMJI*	2	GOVAV*S*	2	RAQ*A*	2	JA*Y	6

MAHODAY	2	FANEK	2	BU*CAR*	2	K*A*	2	BALLEBA*JI*	4	CAMAK	2
NOV*	2	PRATIDIN	2	HAJAROV*	2	GA*Y	2	GEV*DABA*JI*	2	D*A*R	2
BE*LOV*	2	VAD*	2	HINDUFOV*	3	PAVITRA	2	VEV*	2	NAMBAR	3
FAST*AL	2	KA*RYOV*	3	FISI*	5	PRAKA*R	7	FOVAR	2	RAN	10
FES*IYA*FI*	2	KELOV*	2	B*A*RAT	34	PRATINID*ITV	3	MA*RA*	4	DU*SARA*	2
RANAVI*R	2	HEV*	12	NAKAD	5	PURASKA*R	11	S*RI*KA*NT	2	MOHINDAR	2
S*RI	2	FA*NAND	2	S*UKLA*	2	MA*TRA	2	SAHA*RE	4	NYU*JI*LE*ND	4
PRA*DES*IK	2	K*ILA*R*I*	8	ZO	2	KA	16	HAMAR*RI*	2	N*AH	2
SAVA*D*IK	2	PIC*AR*A*	2	VIKAS	2	K*ANW	2	BACA*YA*	2	KAPILE	2
JAGANER	2	WA*V*G	2	Q*ETRA	4	B*O*GOLIK	2	HA*RA*	2	CE*MPIYANOV*	2
FIST*ITI	2	BUNDELAK*ANW	2	SAMA*N	7	JAMI*N	2	VARGOV*	2	YA*D	2
PAT*ARI*LI*	2	KA*RAR*	8	KUFOV*	2	PA*TA*	3	BE*X*I	2	PAHUV*CANA*	2
FISALIYE	5	SIV*C*A*	2	FAVAS*Y	2	RA*TRI	2	JE*SA*	8	CA*V*D	2
SEVA*	3	GUNWE	2	BADAMA*S*	2	TELL*P*ON	2	ST*ITI	9	FE*SI*	7
VYAKTI	7	BAI'KAR	2	T*E*LOV	2	TAMANC*E	2	YOJI*LEND	2	HI*C*	2
C*A*KU*	2	RAK*KAR	3	G*AROV*	2	FANDAR	3	NIRNA*YAK	2	NYOJI*LE*ND	2
PRAVESH	2	PA*KAR	2	VA*RADA*TEV*	2	KAR*NE	2	MAHATVAPORN*	2	SAB*T*	2
SAP*AL	4	SAEV*GE	2	TELI*P*ON	2	FUPAB*OKTA*FOV	2	BALLEBA*JI	2	G*UTNE	2
DARAVA*JE	3	P*ON	2	FUSASE	5	PRAB*A*VIT	5	SKOR	4	CETA	2
ME*V*NE	10	KA*RYKRAM	2	FA*YOJAN	9	MUJ*E	12	FANT	2	PAQ*	4
JANAKA*PI*	2	MILLI*	2	MAN	3	VIC*A*R	2	JAGA*FI	2	JISSE	2
FUTPANNA	3	SAMPRDA*Y	2	PRERAR*A*	2	FA*STRELIYA*	18	VISV	2	HARA*NA*	2
CE*MPIYAN	13	CAMATKA*R	2	HE	6	SA*BIT	5	MRAG	2	MARI*CIKA*	2
TA*JA*	5	SAMA*PT	2	TRIKOR*I*Y	2	BEV*SAN	2	SIDANI*	2	K*ELE	2
FEV*W	2	HEJEJ	2	KAP	2	H*V*K*ALA*	2	SACAMUC	1	JOA	1
FIV*GLE*ND	2	NYUJI*LE*ND	2	K*A*FI*	2	TFST	2	SE*YAD	1	HA*S*IM	1
H*V*K*LA	2	PI*Q*E	2	RAHNE	2	FA*STRELIYA*FI	4	MUSLIM	1	YU*NI*VARSITI*	2
SABSE	3	KAMJOR	2	MA*NI*	2	SPAOT	2	MADRA*S	1	FANTARRA*OTRI*Y	1
FA*SCARYJANAK	2	MA*N	4	HALKA*	2	NAHT*VI*	2	PAL*A*	1	FUSMA*NIYA*	1
MA*NA	2	HALAKA*	2	MA*NA*	2	SAKTA*	2	DEK*ATE	5	FAV*S*A*NUVA*D	1
DIVASI*Y	2	MAHA*RAT*	2	HA*SIL	2	VIH*V	2	FUB*ARATI*	1	CETANA*	2
KAPJI*T	2	BE*ST	2	T*RI*	2	P*FINAL	4	CEYARME*N	1	MA*FIKAL	1
ME*COV*	2	KAPILDEV	2	FA*L	3	RA*N*DA	2	FA*B*A*RI*	1	HU*M*	4
LITIL	2	MA*STAR	2	SANI*	2	GA*VASKAR	4	D*ARMOV*	4	FEKAZIT	1
RAVI	4	S*A*STRI*	2	PICOV*	2	JIMMI*	2	VIQAY	2	JAGRITE	1
AMARNA*T*	2	BV*DARBA*Y	2	FAZAHARUDI*N	2	SACHAMUC	1	MILA*P	1	BALA*A*VA*	1
TORNA*MENT	4	VIS*GV*	2	B*A*RAY	2	DURGA*TI	2	FAB*IVYAKTI	1	D*A*RMIK	3
S*RMNA*K	2	FA*FIYE	2	JARA*	2	NAKJAR	2	MA*NAVI*Y	1	PAHALUFOV*	1
DA*LEV*	2	NYUJI*LE*N*D	2	VIROD*	2	PAHALA	2	TANA*V	3	B*RA*M*TIYOV*	1
6	16	VIKET	12	S*A*NDA*R	2	S*URUA*T	2	Q*EZOV*	2	CIV*TA*	2
9	7	RANOV*	2	LO*Y	2	PA*R	2	MIZATA*	1	S*A*V*TI	2
HAMA*RI	2	PRATIB*A*FOV*	2	JAV*G	2	LAG	4	MATB*EDOV*	1	S*IKA*R	2
								TUKAR*E	2	MATOV*	1

K*O	2	BE*X	2	MOT*ARI*	2	FAGALE	3
MOT*ARI*	2	FAGALE	3	BALLEBA*JOV*	3	B*ARI*	2
BALLEBA*JOV*	3	B*ARI*	2	SIMAT	10	CE*MPIAYANOV*	2
SIMAT	10	CE*MPIAYANOV*	2	FA*SA*N	2	LAQ*Y	4
FA*SA*N	2	LAQ*Y	4	FAMARNA*T*	2	FAJAHARUDI*N	2
FAMARNA*T*	2	FAJAHARUDI*N	2	VIRUDD*	4	PA*IR	5
VIRUDD*	4	PA*IR	5	KUL	2	S*AMANA*K	3
KUL	2	S*AMANA*K	3	FOR*	2	CETAN	2
FOR*	2	CETAN	2	DURGATI	2	KR	2
DURGATI	2	KR	2	RAHEGI*	5	FAPAR*	2
RAHEGI*	5	FAPAR*	2	FEVAREST	2	CAW*NE	2
FEVAREST	2	CAW*NE	2	SITA*RE	2	CH*ONF	2
SITA*RE	2	CH*ONF	2	ME*C*	7	MAHATVAHI*N	4
ME*C*	7	MAHATVAHI*N	4	VA*LA	2	FANTIM	2
VA*LA	2	FANTIM	2	KE*N	2	PAHOV*CE	2
KE*N	2	PAHOV*CE	2	NIYAMIT	2	B*A*RTI*Y	2
NIYAMIT	2	B*A*RTI*Y	3	TEK	2	SA*T	2
TEK	2	SA*T	2	BINNI*	2	PAHOV*CA*	2
BINNI*	2	PAHOV*CA*	2	B*ARAY	4	FA*S*A*YEV*	2
B*ARAY	4	FA*S*A*YEV*	4	HOKAR	2	VIZ*OV*	3
HOKAR	2	VIZ*OV*	2	FA*SA*	2	MA*Z	2
FA*SA*	2	MA*Z	2	HOFI*	2	JABKI	2
HOFI*	2	JABKI	2	P*AFINAL	2	RE*Y	2
P*AFINAL	2	RE*Y	1	DUNIYA*	1	FA*STIKOV*	1
DUNIYA*	1	FA*STIKOV*	1	FUPAKULAPATI	2	FALI*GAI*	2
FUPAKULAPATI	2	FALI*GAI*	1	JANA*B	2	SAYYAD	1
JANA*B	2	SAYYAD	1	FANTAD*A*RMIK	1	SAB*A*	1
FANTAD*A*RMIK	1	SAB*A*	4	FAV*GREJI*	1	FAHAMIYAT	2
FAV*GREJI*	1	FAHAMIYAT	1	SAMPA*DAK	1	MA*NAVATA*	1
SAMPA*DAK	1	MA*NAVATA*	3	FA*D*A*RIT	2	KAMETI*	1
FA*D*A*RIT	2	KAMETI*	1	VA*M*N	1	BRAK	1
VA*M*N	1	BRAK	1	JAHA*M*	4	VIB*INN	1
JAHA*M*	4	VIB*INN	5	SAMMA*N	1	FEKATA*	1
SAMMA*N	1	FEKATA*	1	LOGOV*	1	MEL	14
LOGOV*	1	MEL	1	PARAMPARA*FOV*	1	RACANA*TMAK	1
PARAMPARA*FOV*	1	RACANA*TMAK	1	MU*LYOV*	3	NE*TIK	1
MU*LYOV*	3	NE*TIK	1	PROTSA*HAN	1	SA*MPRADA*YIK	1
PROTSA*HAN	1	SA*MPRADA*YIK	4	YUDD*	1	PI*R*IT	4
YUDD*	1	PI*R*IT	1	VYAKT	2	PA*RASPARIK	8
VYAKT	2	PA*RASPARIK	1	BAL*A*VA*	2	SAV*SA*R	1
BAL*A*VA*	2	SAV*SA*R	2	D*ARM	2	SAMAJ*A*	3
D*ARM	2	SAMAJ*A*	5	FANTAR	1	TAY	1
FANTAR	1	TAY	2				

FA*TANKAVA*DI*	1	TARI*KOV*	1	FA*PAKA*	1	NIMANZAR*	1
SVI*KA*R	2	KARAKE	2	FEHASA*S	2	TAMA*M	2
VIDVA*NOV*	1	FISLA*M	5	FUPAYUKT	1	S*IQ*A*NUSA*R	1
PES*E	1	PRAVAND*AK	1	HU*N*	1	TRAH	1
VIDVAN	1	DA*VA*	1	RAK*ATA*	2	PIC*ALE	7
CA*LI*S	1	SA*	2	LOV*	1	VIV*INM	1
MA*NANE	4	VA*LOV*	8	PA*YA*	1	JIN	2
KARITA*	1	MA*NAV	1	HE*SIYAT	1	KISI*	14
B*INN	1	FISI*LIFE	1	FE*SA*	4	VYA*VAHA*RIK	1
D*ARMNIRAPEC*	1	KAHUM*	1	GALAT	6	KARI*R	2
RAHAKAR	1	MO*KA*	3	FUNAMEV*	2	SAV*K*YA*	1
FI*SA*FI*	1	YAHU*DI*	1	JE*N	1	BO*DD*	1
PA*RASI*	1	SIK*	3	T*E*	3	SAMUDA*Y	2
MERA*	3	VA*STA*	1	JINAKI*	1	GINTI*	1
BEHATAI*N	1	FINSA*NOV*	1	HONA*	1	VYAKTIYOV*	8
BADATARTI*N	1	FINSA*N	1	S*ATA*BDIYOV*	1	BA*VAJU*D	1
FAVAB*IZ*	1	FAC*I*	1	RAK*ATE	3	SAMBAND*	1
JISE	4	J*EZ	5	VYA*K*YA*	2	DIK*A*YA*	1
FISAKF	4	SAMAJ*	7	FA*TE	5	RA*JANE*TIK	2
FE*TIHA*SIK	2	JINHOV*NE	1	HAKI*KAT	1	PARDA*	1
MA*L	1	FISKE	1	KUC	6	FANVYA*YIYOV*	1
FA*CARAR*	1	S*IQ*A*FOV*	1	K*ILA*P**	1	TI*SARE	1
RU*L*IVA*DIYOV*	1	VIROD*I*	1	VICA*R	6	D*A*RA*	3
D*A*RAR*A*YEV*	1	JYA*DA*	6	FUDA*R	1	K	2
MUS*KIL	1	PA*TE	1	MAV*DA*KINI*	6	PITA*	7
SABASE	3	SIV*G*AL	3	MERAX*	1	BAV*MBFI*	1
DARAFASAL	1	BAV*MBAFI*	1	RA*M	6	B*A*RAVA*J	1
JE	2	PI*	9	MEE	1	BETI*	3
SULU*K	1	HE*KI	1	FUSKI*	2	FIMEJ	1
BIGA*R*ANE	1	KOS*IS*	4	RA*JAKAPU*R	1	RU*QT	1
FUNAKI*	10	HI*ROFIN	4	VAHI*	5	FUSANE	10
DIV*PAL	1	VE*SA*	4	SVLU*K	1	FEKS*AN	1
FILMOV*	2	K*ILA*P*	2	PRE"	2	PRAD*A*N	2
KA*RA*	1	S*RI*DEVI*	1	JAYA*PRADA*	1	K*US*I*	2
FEKTRESEV*	1	SI*NIYAR	1	FIJJAT	2	KARATI*	3
SALAL"*	1	FA*GA*	1	HI*RO	2	SUJ*A*V	2
PASAV*D	1	PARIPAKV	1	GAHRE	1	SVARV*P	1
DARS*AKUV*	1	PARICIT	1	KARAVA*NA*	1	FUMRA	1
KIS*OR	1	TA*FIP	1	BAL*E	1		

JITEV*DRA	4	BREK	1	S*A*V*TA*A*M	1	SAC	2
FA*S*A*FOV*	1	K*ARA*	1	FUTARA*	1	JIKRA	1
FA*NE	3	FUSAMEV*	1	FEKTAR	2	NA*CANE	2
MATAKANE	1	LAR*AKA*	1	BAN	6	SAKATA*	8
P*ILMEV	1	B*A*GYAVA*DI*	2	HOTI	1	KYOV*KI	2
DES	1	MIT*YA*	1	LA*B*	2	ML	1
KAHATA*	1	B*A*GY	1	CAL	2	SUNA*TA	1
HU*M	1	MRITYU	1	G*OQAR*A*	1	GAFI	1
MAHAL	1	PAHUV*CEGA*	1	BNA*	1	AFEGA*	1
FITTEP*A*K	1	ROJ	2	VAHA*V*	6	HAJJA*M	2
MEV*V*	2	FEKTRES	1	PARDE	1	JI*VIT	2
LAGATI*	2	NIRMA*TA*FOV*	1	FAV*G	2	MATAKA*NE	1
FALA*VA*	2	YOV*	1	SINEMA*	3	RA*OTRI*Y	1
FEVA*RD	2	JU*RI*	1	JA*NATE	2	SAVAS*REQX*	1
DA*MUL	1	BACAPAN	1	JIMMEDA*RIYA*V*	1	PAR*I*	1
SAP*AR	3	PAHAE	1	B*U**MIKA*FOV*	1	FO*RAT	4
B*A*VANA*FOV*	2	PURU*Q	1	SAKEV*	1	FACC*I*	3
G*A*XA*	1	S*AS*IKAPU*R	3	GIRI*S*	1	KARNA*W	1
NIRDES*AN	1	FUSAV	1	S*URU*	3	K*YA*L	3
FUTSAV	2	SE*KSI*	1	FUTTEJAK	1	JA*FEGI*	1
K*OLAKAR	1	BANA*NA*	1	RISK	1	LENE	1
FAV*TARRA*OTRI*Y	2	KALA*KA*R	2	JINAKE	1	BIKE	1
MA*RKEX	1	BIKANE	1	BATA*TA*	1	JARU*RI*	2
SUB*A*Q	1	G*AFI*	1	RA*HUL	1	K*E*L	1
S*EK*AR	1	KAPU*R	1	P*ILMEV*	6	VYA*VASA*YIK	1
PRIT*VI*	1	T*IFETAR	1	BAV*D	9	NO*BAT	1
SMRITI	1	BANA*YA*	1	P*ARU*K*	1	S*AHA*NA*	2
CUV*BAN	12	FIV*KA*R	1	VIRU*DD*	1	PATI	2
JA*VED	1	VAKA*LAT	2	FANIVA*RY	1	BETA*B	1
DRIS*Y	1	SICU*FES*AN	1	SANNI*	1	RAHANE	3
SABAK	1	FARJUN	1	JAHA*V*	1	SA*RVAJANIK	2
X*AHARA*YA*	1	SAV*SKRITI	1	FISAKI*	3	FANUMATI	2
HOTI*	7	DEK*ANE	3	YUVA*	1	PI*L*I*	1
FASAR	1	ROCAK	1	G*ATANA*	9	VA*NIYA*	1
KA*TANE	1	YUVAK	3	YUVATI*	1	MA*V*GA*	1
'A*V*G	3	KAROGE	2	C*U*T	3	MA*V*GEGE	1
DURUPAYOG	1	JARU*RAT	3	ROKANE	2	SAV*KRA*MAK	1
ROG	3	P*E*L	3	SMITA*	3	PA*TIL	3
K*TIA*P*	1	FA*JAKAL	1	FA*LOCANA*	1	JE*SI*	2
BATA*FU*V*	1	JIMMEDA*RI*	1	SAMAJ*ATI*	1	FA*K*EV*	1
FA*LOCAKOV*	1	DU*V*GI*	1	PITA*P*IA	1	C*OTEPAN	1
FAHASA*S	3	B*AGA*NE	1	BA*TEV*	1	VAHFUSE	1
DA*DA*	2	XOP	2	PAHANAKAR	1	CALA*TE	1
GUSSA*	1	BA*JA*R	1	MASJID	1	FACAKAN	1
K*ARI*D	1	LA*FE	1	KAPAR*OV*	1	C*OTA*	1
KAPAR*E	4	FA*K*IR	1	SI*TA*	6	MA*V*	10
KIV*TU	1	B*U*TAKA*L	1	SAPANE	1	SATA*NE	1
LAGATE	1	LA*PARAVA*HI*	1	BARATANE	1	HARAKATEV*	1
BARDA*S*T	1	PA*LANA*	1	KAX*IN	1	CA*HA*	1
FA*KAR	3	GRIHAST*I*	1	SAV*B*A*L	1	FA*Z*A*	1
FART*I*	1	FA*G	11	LAGA*FE	1	KIV*TV	1
JA*NATA*	1	VA*PAS	1	FA*NA*	1	HA*RDIK	1
FICC*A*	1	SUHA*GAN	1	RU*D	1	MARE	1
RAK*NE	1	FIV*DIRA*	2	GA*V*D*I*	8	JAMA*NE	2
P*I*ROJ	1	NATO	1	FIV*WYA*	1	REBIYO	1
DURDARS*AN	1	JIKR	1	BARASI*	1	KA*RYAKRAM	2
PRASA*RIT	1	FUFE	3	FAVA*V*C*NI*Y	1	MAV*TRI*	1
RA*JI*V	3	GA*N*D*I*	1	REDIY	1	FE*R	4
DURADARS*AN	1	K*UB	1	FUC*A*LTE	1	SARAKA*RI	1
GUN*GA*N	1	JARURI*	1	FATKA*	1	HE*V*FE*R	1
RA*JYA	1	VIDROH	1	SARATE	1	FISLIYFE	1
SAHA*YKOV*	1	LOK	2	NETA*FOV*	1	FUKSA*YA*	1
FA*D	1	B*AJANLAL	1	VIRUD*	4	FA*ROD	1
KI*JIYFE	1	FUNKE	1	VIRODD*	1	KA*RARAVA*FI*	1
FASLI*	1	B*HJANALAL	1	FA*ROPOV*	1	JA*V*C	2
KARA*NE	4	D*A*KI*	1	KA*BU	1	SARVOCC	3
NYA*YA**LAY	1	JAJ	1	SE*V*P	1	SARKA*R	4
B*ROSA*	1	YUVAKOV*	2	NAS*I*LE	1	PADA*RT*EV*	1
K*ARI*DP*AROK*T	1	PU*C*TA*C*	1	KRUDD*	1	FA*KRAMAN*	1
GAR*IYA*V*	1	ULAT	1	DIV*	1	GUSSE	1
FHUFE	1	B*ARTI*Y	1	DUKA*NDA*R	1	MAKA*NDA*R	1
B*ARAT	5	PITX*U*	1	HAMES*A	1	FAFRI*KA*	1
MAD*Y	1	FAMRI*KA*	1	NI*GRO	3	DURYYAVHA*R	1
FIV*GALE*V*D	1	BEKUSU*R	1	B*A*RTI*YOV*	2	FA*KRAMAR*	1
SURU*T	1	FA*VAS*YAK	1	JAVA*HAR	1	LA*L	1
NEHRU*	1	NI*TI	1	JAGATGURU*	1	BANANE	3
LA*LSA*	2	SOCSAMA*J	1	PARIVARTAN	1	KARE	1
KA*LE	2	JAGAH	1	HIT	6	FABHELNA*	1
JE*SA	1	PAV*KITYOV*	1	CUKA*	8	KA*NUN	1
MUKADAMOV*	1	JANM	5	DEA*	1	KA*NU*N	2
FADA*LATOV*	1	PRABAV*D*	1	SATA*RU**W*	1	K*AR*	1
RA*JANI*TIBA*J	1	FUCC	1	NYA*YA*LAYOV*	1	JAJOV*	1
B*ARATI*	1	KAX*INA*I*	1	VAHAV*	1	BE*X*	1
FAKSAR	2	CAMACE	1	NIQPAQ*	1	PRAKRIYA*	1
NYA*Y	2	FOE*R	1	MILE	1	FANYA	3
SARKA*RI*	1	SEVA*FOV*	1	BAS	9	G*AR	8

FITNI*	1	GOPANI*YATA*	1	BARATANEVA*LE	1	FA*JA*D	4
DIK*A*NE	1	SVAYV*	1	D*ANY	1	KITANE	1
FA*TMGO*RAV	1	FNUB*AV	1	RAHA	1	B*A*VNA*FOV*	1
S*ABDOV*	3	BA*V*D*	2	PA*NA*	1	SAMB*AV	2
SISAKATE	1	DEK*KAR	2	FUNSE	2	MUV*H	7
S*ABD	2	SUNKAR	3	FUFUNKI*	1	SISKIYA*N	1
SVAT	1	GAYIV*	1	FA*V*SU	1	POV*C*	1
DA*LE	1	VA*STAV	2	FAJA*D	1	VISTRAT	1
FART*	1	BANATE	1	JINKA*	1	SAV*Q*EP	1
YAHA	1	KAHIV*	1	FA*GA*H	1	B*ARARA*	1
ZIVEDI*	4	TAHASI*LDA*R	1	FA*JA*O	1	MULA*KA*T	3
KARVA*YI*	1	FA*DMI*	1	B*AROSE	1	MA*LU*M	1
MAGAR	4	SVATAV*ZA*	1	FA*NDOLAN	1	PAT	1
CALATE	3	YADD*API	1	TAHSI*L	1	DA*R	1
ZIVEDE	1	FA*SVA*SAN	1	D*AN	2	PADONNAI	1
FUSKE	3	PAKAR*VAR	1	FAJI*B	1	MUJ*	2
FA*S*V*KA*	2	PRAKAT	1	RASU*K*	1	VYAKI*GA	1
SAV*HAV*D*	1	MESIV*G	4	FUSKI	1	FALO*KIK	1
S*AKYIYOV*	1	PUC*A*	1	JYA*DA	1	MULA*KA*	1
RU*L*	1	K*AJA*V*CI*	1	GALATI*	1	BECA*RE	1
DO*RA*	1	DEK*E*	1	NAS*VAR	1	PRAST*A*N	1
RU*S	1	GUPTACAR	1	MUK*IYA*	1	FUSKO	3
FAGRIM	1	KIYE	8	STA*LIN	1	MILANE	1
NICV*ITATA*	1	SAB*I*	7	KARMCA*RIYOV*	2	SAMAJ*KAR	1
K*A*NE	3	SAV*YOGVAS*	1	DA*KTAR	2	FEBAL	1
CINH	1	MAHASUS	1	MURDA*K*A*NE	1	NIKALVA*KAR	1
SUB*A*N	3	SIVANI*	1	ST*IT	3	SASURA*L	1
HAGA*R	1	CA*V*DI	1	JEVAR	1	FISTARAH	1
MA*L	2	BARA*MADGI*	1	SOEV*P	1	PRAS*N	5
VYAVASA*YI*	1	ROGMUKT	1	X*AG	1	RAMES*	2
SA*HU*	2	VIS*V*S	1	PAGALE	1	TU*	1
FID*AR	2	DO*LAT	1	B*ATAK	1	MAYA*	1
TERE	1	LA*LAC	1	VE*SA*HI	1	TAB	2
SAMBHAV	1	HADAME	1	FI*S*VAR	1	C*OR*	2
LAGH*AG	1	PE*V*TALIS	1	MTNAT	2	FANGINAT	1
BANDU*K	1	D*XRI*	1	C*A*YA*FEV*	1	DIK*A*YI*V*	1
DI*V*	1	JA*NEVA*LA*	1	NO*JAVA*N	1	BANDU*KD*ARI*	1
G*ER	1	CUKE	2	FUSMEV*	5	CALO	1
FINHEV*	1	RAJA*JI*	1	P*E*S ALA*	1	DEV*GE	1
JAK	1	BA*RAH	1	BAJ	1	C	1
MAHI*NE	1	YUDD*RAT	1	PU*RV	2	KARAN*VAS*	1
FANUPASTIT	1	HOGAYE	1	LO*LNE	1	BATA*LIYAN	1
RAV*CI*	1	LO*TI*	1	GERHA*JIR	1	KE*FIYYA*	1
TALAB	1	FUPA*D*YA*Y	1	KAHANA*	6	PU*C*A*	2
JANA*	1	C*NIFE	1	FANTAT	1	BAR*	1
MA*HATA*B	2	TIRYAK	1	DROTI	1	BOLI*	3
PI*C*E	3	K*AR*E	3	DAK*AL	1	FA*PKI*	1
TU*T	2	JAYE	2	BESUD*	1	SOC	2
RAHI	1	BATA*FIYE	1	D*R*AK	1	PALOV*	1
ST*IR	2	K*R*E	1	SUNIYE	1	PUKA*RA*	1
JA*FIYE	2	BOLANA*	1	FA*PSE	2	C*PA*YE	1
BA*TOV*	1	BATOV*	1	KAHLVA*	1	LETE	2
DEK*HA	1	FA*PNE	1	S*AKI*LA*	2	FAPNATV	1
NABI*	4	DEK*TE	1	P*ARIS*TOV*	1	LACC*AN	1
JOK*IM	2	BATA*NE	1	LA*YAK	1	HI	3
TA*RI*P*	1	DEK*I*	2	K*ISAK	1	YU*V*	3
DEK	1	TI*NOV*	1	RAS	1	LIPT	1
MA*HTA*H	1	LA*J	1	DOHRI*	1	G*UTANOV*	1
C*IPA*	1	VIDA*	1	BA*KAR	1	TATOLANEVA*LI*	1
NAJAROV*	1	TUJ*E	1	Y	1	FA*YI*	1
C*I*K*	1	DI*V*D	1	PAL	1	STABD*	1
G*ABRA*YI*	1	PU*RA	1	D*AD*K	1	GRAHAST*I*	1
LAPATV*	1	FUT*	1	RAHIV*	1	GUHA*R	1
SULAG	1	C*OJAN	1	NI*C*E	1	K*V*C	1
BEHOS*	1	BA*HOV*	1	TA*V*GE	1	KONR	1
SU*K*	1	KARBI*	2	JALT*	1	BOJ*	1
K*ISAKKAR	1	FANDARSE	1	NIKA	1	*LKAR	1
FA*GAN	1	RAK*	3	DIYA	3	HEMA*	5
VAJAH	1	RU*P	4	FI*S*A*	1	PA*LAN	2
POOAR*	1	FAV*T	1	G*U*M	1	P*IRAKAR	1
VAHIV*	1	DIFOL	3	P*E*MILI*	4	BADALA*	1
D*ARMENDRA	1	FALAG	3	KARAVA*	1	DOBA*RA*	2
D*ARAM	1	NAYA*	2	MOR*	2	FA*FEGA*	1
CALEGA*	1	WA*KXARI*	1	PAL*A*FI*	1	PU*RI*	2
FIV*DAR	2	LO*XATA*	1	FANUPAST*ITI	1	DUNIYA*V*	1
FUJAR*	2	SUMIT	1	BEVAP*A*FI*	1	DETI*	2
PA*GALAPAN	1	FA*DIVA*SIYOV*	1	D*I*RE	2	MASI*HA*	1
FA*DIVA*SI*	1	LAR*AKI*	1	S*OB*A*	1	FA*NAV*D	1
YAS*APA*L	1	NIGA*HEV*	1	JUHU*	1	BANGAV*LE	1
T*I*K	1	YEH	4	CARCA*	8	GARM	1
RAHATI*	3	HATYA*	9	VALA*	1	NHIV*	1
FUSKA*	1	BA*P	1	KUS*AL	1	FA*PKO	2
DEK*	2	TASALLI*	2	VARANA*	1	FO*	1
BE*T*E	3	BAD*A*FI*	1	MAMMI*	2	LAGA*TI	1
DAR	2	JATA*	2	MAHILA*	2	S*AKL	1

MAV*DA*KINI	1	FASALI*	1	SAVA*LOV*	1	J*AR*I*	1
KO*N	1	PU*C*ANA*	1	LIK*EV*GE	1	LIK*NE	1
VALE	1	FINKO	2	TUMAKO	1	FA*VAJ	1
P*OTOGRA*P*AR	1	P*OTO	1	C*A*P	1	DI*JIYE	1
MISEJ	1	JOJAP*	1	YA*NI*	1	BA*TCI*T	1
BE*T*	1	SACMUC	1	CALA*FI*	1	SUNATE	1
LIHA*J	1	ROMA*V*S	4	FA*FI*V*	1	SAHAN	2
FEKADAM	1	FIJU*L	2	FAPVA*H	4	SACCA*FI*	1
JITANA*	1	PARSE*NTEJ	1	VOMA*V*S	1	FAPBA*HEV*	1
RAHI*V*	3	JISM	1	KAHI*V*	4	JAK*M	1
KA*NIS*A*N	1	PITA	1	FITANE	2	DUS*MAN	2
CALA	1	FUNAKO	1	KYA	3	PA*GAL	1
HU*	1	SA*MANE	1	SW	1	ROMAV*S	1
KARU*V*GI*	1	PI*T*	1	PIC*E	1	FPVA*H	1
P*E*LI*	1	FAP*VAHE*	1	NIKALTI*	1	HE*V	1
TERI*	1	GANGA*	1	ME*LI	1	RAK*ANE	1
K*ABAROV*	1	YA*NI	1	P*E*LA*NE	1	FA*PAKA	1
GA*LI*	1	CARCA	1	RAHANA*	1	CA*HEGA*	1
TERI	2	PRASID*I*	1	DA*H	1	SAKU*V*	1
BARE	2	K*ABAREV*	1	FUR*A*	1	P*A*YADA*	1
LA*FIN	1	G*ATIYA*	1	MERA	1	MATALAB	1
O	2	SAP*ALTA*	1	K*ABARE	1	P*E*LVA*TI*	1
DUS*AMANI*	1	BAR*A*NA*	1	PAZIKA	1	C*APA	1
HOTAL	1	COLA*	1	NAV*GA*	2	DA*V*S	1
BEP*IKTI*	1	TAMAS*A*	1	BATA*FIFE	1	PABLISITI*	2
RAM	1	K*AD	1	FUR*A	1	DOSTOV*	1
PURI*	2	TARA*H	1	BARBA*D	1	C*AHATE	1
K*ABA	1	K*V*DAN	1	PAZIKA*	1	PA	1
KES	2	K*V*ADAN	1	KARTI*	1	K*ELANA	1
C*A*HATE	1	LIK*	1	BEFIJJATI*	1	HOTA	1
F*OR	1	BA	1	STE*V*D	1	NA*K	1
G*UASATI*	1	SAR*AK	5	FAHIV*SA*	1	MA*RG	1
KIS	2	KAMBAK*T	1	DA*N	1	B*AGVA*N	1
KASAM	2	K*AFI*	1	FAB*I	1	TRAV*K	1
DA*YAN	1	DAYANA*	1	CEHARE	1	FA*NA	1
JA*FEV*	1	HIV*SAK	2	GAW*W*OV*	2	S*ARI*P*OV*	1
B*A*S*A*	1	KAHIYE	1	CALATA*	1	MAHA*MA*NAV	1
KA*LI*	1	MIRC	1	SAMAJ*ATA*	1	HAMA*M	1
DASTE	1	NAGARPA*LIKA*	1	BA*LIKA	1	DURGA*SAN	1
MUHABBATNA*MA*	1	B*IJVA*YA*	1	CAV*DI*	1	SIR	2
BALI*	1	CAN*	1	MARAHAM	1	PATTI*	1
FINAYAT	1	GAV*JE	1	BA*L	3	FUGE	1
GAD*E	1	SI*V*G	1	ROJA*NA*	1	BISMILLAH	1
KARTE	2	KAP*AN	1	CALANE	4	FI*D	1
BAKARE	1	MILTA*	2	R*U*SA*	1	DIMA*G	1
FAJV*R	1	PAV*JAR	1	FITANA	1	FUT*ALA*	1
PUT*ALA*	1	NARASOV*	1	SUB*AH	1	KISSA	1
PAKAR*ARE	4	FIANI*	1	CALE	3	GOYA*	1
KISI	1	JEB	1	KA*T	1	HOV*	1
BA*RIS*	1	HATI*	1	FADDE	1	SUNDARI*	1
KICAR*	1	FITARA*	1	MA*NOV*	1	KOI*	1
FAFI*	2	VIVA*H	1	HETU	2	RAP*AA*R	1
BACI*	1	K*UCI	1	P*URTI*	1	DIK*ALA*	1
GAW*W*H*I*	1	PAHIYA	1	P*UL	1	TA*S	1
P*LORA*	1	P*A*FUNTEN	1	C*AKKE	1	HAMARE	1
PAVIZ	1	PE*VELIYAN	1	PAR*A	1	FA*NAN	1
P*ANAN	1	STA*R	1	TRE*K	1	JI*V	3
DAP*ATAR	2	PAHUV*CANE	1	FUT*A*	3	DA*LATE	1
MEKAP	1	JAMHA*FIYA*V*	1	MO*N	1	J*V*DE	1
DAV*DE	1	SAMET	2	FUTA*R	1	JA*TA	1
CA*LIS	1	BYA*LIS	1	FAV*TARA*X*TRI*Y	1	MAHA*S*OK	1
G*OX*	1	PARASOV*	1	S*A*M	1	LO*T*TE	1
FANNAY	1	JAG*NY	1	PITA*FI*	1	BAC	2
BECA*RA*	1	FAZA*	1	BAGULE	1	K*AR*A*	1
SARA*	1	SUK*PU*RVAK	1	FUA*	1	FAD*D*E	1
G*USATE	1	PATALI*	1	KAMAR	1	K*A*YA*	1
FA*DARX*YA	1	BE*V*GAN	1	NIRDALI*Y	1	FE	5
FUC*AL	1	GIRA*	1	FIMRA*N	1	LUW*AKATA*	1
YA*ZI*	1	FANA*YA*S	1	CI*K*	1	FUC*ALA*	1
BACO	1	FIR	2	FA*D*I*	1	SAVA*RIYOV*	1
GARDANEV*	1	K*IR*KIYOV*	1	BACE	1	HFE	1
S*URVI*ROV*	1	FUV*GALIYA*	1	FAV*GUT*E	1	SU*J*A*	1
KA*NOV*	1	T*UV*S	1	K*IR*KI*	1	KU*D	1
MEV*W*AK	1	PARICAY	1	SAP*ARNA*ME	1	PRST*	1
LIK*A	1	BI*VI*	1	NA*MA*LU*M	1	NA*S*E	1
K*I*R	1	BIC*A*	1	PAROSAI*	1	DAHI*	1
BI*S	4	FAK*BA*ROV*	1	JA*YE	4	BACA	1
JAV*HA*V*	1	S*AHARO	1	PURN*	1	YA	1
FA*SIV*K	1	KARP*YU*	5	PUJA*RI*	1	TARANTA*RAN	2
T*A*NEDA*R	1	KATL	1	JA*LAV*D*AR	7	DUKA*NEV*	1
JALA*	1	P*ILO*R	1	HAT*GOLA*	1	P*E*KA*	1
JISASE	2	BA*JU*	1	MUKTSAR	1	HIV*SA*	3
P*AYRIV*G	1	G*AYAL	1	BI*BINN	1	ST*ANOV*	1
G*ATNA*FEV*	2	MANOBAL	4	GIRA*VAT	1	FA*NI*	1
SVARN*	2	MAV*DIR	2	NIRDES*	4	PARA*KA*QT*A*	1

HUFI	1	DAHA*R*E	2	H*I*	29	FATWA*L	1				
FAMRATSAR	4	DEHA*TI*	1	Q*ZOV*	1	T*A*NOV*	1				
DARVA*JE	1	D*ALTE	1	YADI*	4	JADA*	2				
BACA*V	2	PUKAR	1	JANBA*B	1	TUMHEV*	1				
BACA*FEV*	1	BACEV*	1	BAKO*L	1	KA*V*GRESI*	1				
NETA*FO*V*	1	FAGE*	1	B*AGATI*	1	HATYARE*	1				
FUSAE	1	PI*CE	1	HE*RA*N	1	CA*HE	2				
KITANI	1	FAPRA*D*I*	1	HAT*	1	SA*P*	2				
VISTA*R	1	PIC*LF	1	DARJ	2	RAHE*	1				
BOLTA*	1	PRAMA*N*	1	SAS*ASZ	1	FUGRVA*DIYOV*	3				
MAKBU*L	1	PURA*	1	CO*K	1	HE*D	1				
KA*V*STEBIL	1	SIPA*HI*	2	TARSEM	1	SIV*G	1				
G*A*YAL	2	KARMIYOV*	2	RA*FIFALEV*	1	LU*T	1				
HE*V*DS	1	FAP	1	KARKE	1	HAT*IYA*R	6				
SO*V*PANE	1	FUNOV*NE	1	TURANT	2	FA*TMSAMARPAN*	1				
SO*V*P	1	FUGRVA*DI*	2	PE*DAL	2	MARC	1				
K*ALAR*A*	1	FES	12	FAI*	1	VED	2				
PRAKA*S*	2	HARJI*T	2	SIV*G*	2	FA*VA*S	1				
CALA*YI*V*	1	R*A*R*	1	SIVILLA*FINS	1	FI*LA*KE	1				
FA*TAV*K	4	FUNAKA	1	LIST	2	FUNPE	1				
GALATP*AHAMI*	1	HAMALA*	2	FULLEK*NI*Y	1	FANA*M	1				
JI*P	5	ROKA*	1	P*AYARIV*G	1	GA*RD	2				
DRA*FIVAR	1	JABA*BI*	1	P*AYFRIV*G	1	HAMLA*VAROV*	1				
BE*DMIV*TAN	1	RAPAT	1	T*ANE	1	KARA*	1				
*FUT*ATA*	1	*FAK*IR*	1	*PARIST*ITIYA*	1	*JISME*	2				
D	1	DVA*RA	2	PI*CA*	1	MEV*FE	1				
B*U*PENDR	1	MA*RKAR	1	DOPAHAR	4	K*ANA*	1				
KH*ANE	1	MOTAR	1	SA*FIKAL	1	STA*RT	1				
TARAHA*	2	KAPU*RT*ALA	1	KA*V*D	3	FUGRAVA*DI*	1				
KOT*I	1	BARA*D	1	SPI*D	1	GOLIYA*V*	1				
BARSA*TE	1	FITANA*	1	NAHI	1	KAPU*RT*ALA*	1				
K*U*NI*	1	G*V*TE	1	FAV*DAR	1	RAHASYAPU*RN*	1				
HARI*	1	SAVA*R	1	FUGRAVA*DIYOV*	9	JASSOCA*YAL	1				
FIV*SPE*KTAR	2	JASKI*RAT	1	SA*RA*V*S*	1	HO*SALE	1				
FAD*IKA*RIYOV*	2	C*I*N	1	DAHAR*E	1	HATYA*FEV*	1				
HATYA*RO	1	BACATE	1	DAYANI*YA	1	FANUMA*N	1				
LAGAYA*	1	GAT	3	KA*R	2	JISMEV*	1				
STENGAN	1	D*ARI*	1	SUB*ANPUR	1	STENGAND*ARIYOV*	1				
STENGANOV*	1	VA*L	1	NA*KA*	1	C*OR*KAR	1				
NIKALE	1	GI*	1	ROD	1	RANI*	1				
DUKA*NOV*	1	C*IPE	1	BASAV*T	1	VIHA*R	1				
MA*DAL	1	TA*FU*N	1	G*U*MATI*	1	MUK*YAMAV*Z*I*	1				
SARDA*R	1	SURJI*T	1	BARNA*LA*	1	SAV*BAND*	1				
LA*	1	FEV*D	1	FA*RDAR	1	KJI*	1				
BALKI*	1	RAJNE*TIK	2	SAMAJ*ATE	1	FESA*	1				
VA*STVIKTA*	1	DRAOTI*VIGAT	1	DA*YITV	1	DA*LANE	1				
FANARU*P	1	SAMJ*O*TE	1	SAV*T	1	LO*GOV*VA*L	1				
CAV*DIGAR*	1	TAB*DLE	1	TA*RI*K*	1	KRAM	1				
NIRANTAR	1	CALATA	1	BAR*TA*	1	RAHATA	1				
C*EZOV*	1	VARTMA*N	1	PARIST*ITIYOV*	1	DRAOI*GAT	1				
KENDRA	5	BARANA*LA*	3	FA*TAV*KAVA*D	3	SAP*A*YE	3				
DIS*A*	3	PU*RR*	3	SAHAYOG	3	FA*S*VA*SAN	3				
FARD*	3	SE*NY	3	BALOV*	3	XUKAR*IYA*V*	3				
B*EJI*	3	NAKODAR	3	KARP*YU	3	BAJF	7				
KRAMAS*	3	N*I*L	6	G*AXANA*	12	HUYI*	3				
FILA*KE	3	G*EREBAV*DI*	3	KINTU	3	FINKA*R	7				
TA*V*GAR*I*	3	BAXA*LA*	3	H*AMIK	6	CA*KU*	3				
MA*RAKAR	6	FA*HAT	6	GOPA*LAGAV*J	3	BIHA*R	3				
RA*JA*PUR	3	NIVA*SI*	5	BANA*NE	4	HAMALA*VAROV*	3				
SUKK*U*	3	NA*MAK	4	LA*X*I*	3	FASPATA*L	5				
PAHUV*CA*YA*	3	DAS*A*	3	CINTA*JANAK	3	RATN	2				
PIC*ALI*	3	MADAR	3	XERESA*	3	PADM	9				
VIB*U*OAR*	5	FA*MXE	3	FUPARA*OTRAPATI	6	KE*D	6				
KA*HIRA*	3	FEPI*	4	SU*HA*NI*	3	FADA*LAT	3				
PRAT*AM	4	FOMAR	3	FAL	3	TA*YEB	3				
PADMAH*I*	3	VILIYEW	3	GI*T	3	SEX*I*	5				
FAMPA*YAR	3	SVARU*PAKRIOR*	3	S*ATARAV*J	3	SUH*I*	6				
FANUPAMA*	3	FAB*AYAV*KAR	3	MOHAMMAD	3	S*A*HID	3				
WA*	3	MIH*A*	3	HASTA*O*AR	3	LIK*A*	3				
RU	3	J*OLE	3	PURA*NE	3	SXI*L	3				
GILA*S	3	HA*LA*V*KI	3	KASBE	3	JULAKIYA*	3				
HAMADA*NIYA*	3	MOHALLOV*	3	DES*I*	3	P*ATE	3				
SADASYI*Y	3	KE*BINET	3	DAS	3	GYA*RAH	3				
MAV*NZIYOV*	3	HAXA*	3	MANZI*	3	HAXA*YE	3				
JA*YEV*GE	3	PA*RXI*	6	SO*V*PE	3	FA*S*A*	3				
FANNA*DRAMUK	3	PRACA*R	3	JAYALALITA*	3	BE*X*AK	4				
SAMBOD*IT	3	KA*RYAKARTA*FOV*	3	FA*VA*HAN	6	MATAB*EDOV*	3				
B*ULA*KAR	3	BEGUNA*H	3	GIRAP*TA*RI*	3	FASAV*TOO	3				
VYA*PT	3	SUDA*R	3	FUPADRAVOV*	3	SAK*TI*	3				
NIBAXANE	3	B*U*MIKA*	3	SPAQX	3	SIK*OV*	7				
RIJARV	3	GE*R	3	NA*REBA*JI*	3	SU*CANA*FOV*	3				
FURAVA*DIYOV*	3	FISTEMA*L	3	VA*HAN	3	FUPALABD*	3				
KARA*YE	3	VIPAO*I*	4	NETA*	4	GRIHAMAV*ZI*	3				
FUNASE	3	MILEV*GE	3	PRAD*A*NAMANZI*	3	SADAN	6				
MASALE	7	SARAKA*RI*	3	KA*RYA*LAYOV*	3	SA*MA*NY	3				

JAMMU*	3	PRAS*A*SAN	3	KA*LEJ	5	PRAS*NOTTAR	4
ST*AGIT	7	GAMB*I*R	3	KARA*YI*	3	FAV*GREJOV*	1
RA*QTRVA*DIYOV*	1	SAN	2	SAV*GRA*M	1	FA*RAMB*	1
FAV*GREJO	2	C*OR*O	1	JANATA	1	FUX*	1
K*ARI*	1	KRA*V*TIKA*RIYOV	1	BAMOV*	1	BAV*DU*KE	1
S*A*SAN	1	HILA*	1	SAMART*AN	1	BA*BJU*D	1
FAV*GREJ	1	S*ASAK	1	MAHA*N	1	FA*V*DOLANO	1
FA*V*NDOLANKA*RI	1	DABA*NE	1	PRA*KAR	1	VARQO	1
FA*JA*DI*	1	HAMARI*	1	LAR*A*FI*	1	X*APP	1
VA*DI*	1	FAK*A*LI*	1	PRATI*	1	DIL*	1
HAMDARDI*	1	KARAN*	1	VA*DIYOV*	1	DAMAN	1
P*O*J	1	DAHEJ	1	HATYA*YOV*	1	SA*Q*Y	1
FA*VKALAN	1	LAQ*MAN*	1	SA*S	4	S*AKUNTALA*	1
MITTI*	3	TEL	4	BAHU*	3	SUD*A	1
C*IR*AKE	1	CAS*MADI*D	1	GAVA*H	2	KA*MOV*	1
CASMDI*D	1	PRA*Y	1	SAKATA	1	KYOV*KI*	1
MU*JU*D	1	C*IR*AKA*	1	LAGA*NA*	1	PARANTU*	1
FAMUK	1	TARI*KE	1	PARI*VA*R	1	FA*ST*A*FOV*	1
MA*NYTA*OV*	1	FANU*SA*R	1	TARIKA*	1	PRATI*DIN	1
BAW*ATA*	1	PA*RIVA*RIK	1	VE*VA*HIK	1	PRAB*AV	1
PAR*ATA*	1	DONO	1	JAVA*N	1	FAT	1
B*A*VUK	1	B*AVUKTA*	1	KABU*	1	JESE	1
PATI*	2	SVAYAM	1	C*IR*AK	1	STOV	1
SIDD*A*NT	1	SAMB*A*VANA*	3	FAB*IYUKT	1	NIRDOQ	1
MA*NANA*	1	CA*HIYE	1	SID*A*NT	1	PARIST*ITI	1
FA*ST*AFOV*	1	MA*NYATA*FOV*	1	FAR*ANA*	1	FAPRA*D*	2
TARAP*	1	MU*LYA*V*KAN	1	PAR*EGA	1	SAVTAV*ZATA*	1
VAKTITV	1	PRA*PTI*	1	SAV*G*AQ	1	LIYA	1
DOQA*ROPIT	1	SASUR	1	SASU*RALAOV*	1	DOQI	1
MANANA*	1	UYA*YOCIT	1	SAHI*	1	SAVV*Y	1
KASU*RVA*P	1	SAVARN	1	FUK*AR*	1	KROD*	1
MUSAHAROV*	1	PI*TA*	1	S*OS*IT	1	RA*MJANYA	1
FEWAVOKET	1	BATAYA*	1	FUKT	1	DURB*GYAPU*RN*	1
SA*LDA*T	1	T*AUA*	1	HURMUJPUR	1	B*AYAB*I*T	1
MUSAHAR	1	BACCOV*	1	GA*V*	1	KOTSAV	1
FAPRE*L	5	MANA*YA*	1	FAVSAR	1	PRA*T	2
SAV*D*YA*	1	YAZ*	1	SA*V*YKAL	1	B*AJAN	1
PRAVACAN	1	MAV*ZO	1	SASVAR	1	PAT*	1
SAV*SKRAT	1	SAB*AQAN*	1	VADD*	1	BRANDOV*	1
VA*DVIVA*D	1	NA*TAK	2	FA*DI*	1	BA*LIKA*O*V*	1
S*ASZASAZ	1	SAV*CA*LAN	1	YOGA*SAN	1	D*ANURVIDD*A*	1
CAMATKA*RI*	1	PRADRS*AL	1	KA*S*I*	1	FOM	1
YA*DAV	2	PA*NDE	1	D*ARMS*A*LA*	1	BAGAL	1
KUV*FA*	1	GANDA*	1	MAHA*PA*LI*CA*	1	KARA*FEV*	1
TA*KI*	1	RA*D*ES*YA*N	1	KESARI*	1	RA*JENDRA	1
TIVA*RI*	1	FA*DI	1	SA*V*SAD	1	S*YA*MLA*L	1
MAV*DAL	1	FA*HATOV*	1	K*OJAVA*V*	1	B*ARATLA*L	1
LA*PATA*	1	KATVA*NE	1	LO*TE	1	B*ELU*PUR	1
FAPHARAN*	1	MURGA*	1	GARAJ	1	VA*RA*N*ASI*	1
JESI*J	1	NA*GARI*	1	MAV*DALI*	1	RA*ZI*	1
PARAM	1	MU*RK*	1	KIYA	1	GURU*DVA*RA*	1
PRAB*AV*D*AK	1	MAHA*NV*ZI*	1	HAPBV*S*	1	G*ATANA*YOV*	1
Q*OB*	1	KAX*OR	1	KA*RVA*FI*	1	JANTU*	1
VIZ*AN	1	PRAYOGA*TMAK	2	PARI*Q*A*	2	KI*SAMB*A*VIT	1
TIT*I*	1	VISTRIT	1	JA*NKA*RI*	1	PARI*Q*A*RT*I*	1
BIB*AGA*D*YAQ*	1	DA*	2	FEC	1	GANDEVIYA*	1
B*ARTIYE	1	MAJDU*R	1	JILA*	1	DINQOV*	1
RA*MNAGAR	1	RA*JKI*Y	1	BA*LI*CA*	1	FINTAR	1
PRAD*ANA*CARY	1	SU*CIT	1	KENDR	1	SAV*ST*AGAT	1
VYAKTI*GAT	1	HA*FI*SKU*L	1	KI*Q*A*ZA*OV	1	GRAHAVIZ*A*N	1
FAPREL	1	MEVA*LA*L	1	PA*L	3	SMA*RAK	1
VA*LIVA*L	1	PRATI*YOGI*TA*	1	SA*V*Y	2	KAMPA*FUV*D	1
TE*LI*P*O	1	FEKSCEV*J	1	ME*DA*N	1	PADA*D*IKA*RI*	1
CUNE	1	MAHA*NAGAR	1	LOKDAL	1	VARIQX*	2
FUPA*D*YO*	1	SAV*KATA*	1	PA*V*DEY	1	FURP*	1
GURU*	1	VAKTAVY	1	MAHA*PA*LICA*	1	FAD*IKA*RIYO	1
V*	1	NIYAM	1	TA*K	1	VASU*LI*	2
D*AMAKI*	2	JANE	1	KATU*	1	NIV*DA*	2
BA*V*S	1	P*A*TAK	1	NIRD*ARAN*	1	MA*MAL*	1
NYA*YA*LAY	1	NIRAST	1	BABJU*D	1	RAVE*YE	1
BADLA*V	1	KA*RVA*HI*	1	CARIT	1	MA*NAS	1
SAV*G*NE	1	SABJI*	1	MAV*DI*	1	EPA*S	1
SUV*DAR	1	PA*X*	1	HOLI*	4	CITVAR*A*	1
BABBAN	1	VYAKTI*	1	S*AM	1	LO*T	1
ST*AL	1	MRATYU*	1	MRATAK	1	B*AFI*	1
FIS*	1	RA*QTRAPATI*	2	B*AVAN	2	DARBA*R	2
FA*YOKIT	2	SA*DE	2	SAMAROH	2	JE*L	2
PURUSKA*R	4	VITARIT	2	B*U*QAR*	4	PADMH*I*	2
PRADA*N	2	LAGATA*R	2	C*AX*E	2	KODES*	2
NA*GARIK	2	FAMRI*CA*	2	P*RA*V*S	2	B*AA*RAT	2
MAHOTSAV	8	LIYAE	2	B*A*RTIYE	2	SAMMANIT	2
JINME	2	P*RAV*S	2	SAMITI	3	DIVGAV*T	2
JI*N	2	RI*VO	4	KRAQANA*A*	2	GRAHAN	2
PADMB*UAR*	2	SAMBAV*D*IT	2	RAJEEV	2	SAMI*TI*	2
FAMARI*KI*	2	W*ILLO	2	RIPALE	2	MARTAD	2

PET	2	PRASID*	6	VIS*EQAZ*	2	FEN	2
TAV*DAN	4	SA*MA*JIK	2	KARYKARATA*	2	H*I*MATI*	2
FILA*	2	B*ATT	2	KOL	2	FIV*DIYA*	2
LIMITED	2	LEP*TI*NEV*T	2	FAVKA*S*	2	MANOHARLA*L	2
C*IBBAR	2	D*RUPAD	2	GA*YAK	2	FAMI*NUDDIN	2
DA*GAR	2	VE*Z*YA*NIK	2	B*ARGAVA*	2	GUJARA*T	2
RA*JYA*	2	B*U*TPU*RV	2	CUNA*B	2	FA*UKT	2
KRAQAN*	2	VE*Z*YANIK	2	FA*R	2	FARU*NA*CALAM	2
SALHA*KA*R	2	BOD	2	NAYI*	2	VIB*A*GOV*	1
KA*RYARAT	1	LA*GU*	4	PRAKRITI	1	SAMBAND*I*	1
PRASTA*V	2	VETANAFA*YOG	1	PRAS*A*SANIK	1	SUD*A*R	1
TAHAT	2	FANUMODAN	1	FA*YOG	1	SAPTA*H	1
H*ER*I*	2	VARTAMA*N	2	VETANAMA*NOV*	1	VARGI*KARAR*	1
SEKS*AN	1	FAP*ASAR	1	FANUSACIVOV*	1	VETANAMA*N	4
NAYE	1	MAHAV*	1	GA*FI*	1	B*ATTA*	1
MU*L	1	MILA*KAR	1	MAHAV*GA*FI*	1	LANDAR	1
LAV*DAN	2	PARAK*ANALI*	1	S*IS*UFOV*	2	JANMA	1
SAV*WE	1	PI*PUL	1	SAMA*CA*RAPAZ	1	BUD*AVA*R	1
YU*NIVARSITI*	1	FINAKA*	1	VAJAN	1	JE*KAB	1
SEN	1	GAHARI*	1	VIMARS*	1	RTN	1
BALARA*M	1	JA*K*AR*	2	PRO	1	DAV*DAVATE	1
SAHAMATI	1	HATYA*FOV*	1	KAR*E	2	JA*NI*	1
K*ED	1	SA*V*PRADA*YIK	2	RAV*G	1	ROQ	1
BA*V*XANE	1	SAMAJ*ADA*R	1	D*ARMANIRAPEQ*	1	RA*QXRAB*AKT	1
KARNA*XAK	1	MUK*YAMAV*ZI*	1	KRIQR*	1	HEGAR*E	1
SAV*DEH	1	G*AXANA*FOV*	1	SA*JIS*	1	FAST*IRATA*	1
SAV*VA*DADA*TA*F	1	TA*KATEV*	1	PU*RVT*	1	KRARANA*	1
TILAK	1	CETASIV*H	1	S*IQ*A*	1	SAV*ST*A*N	1
PRA*V*GAR*	1	RA*MA*PURA*	1	NA*RMAL	1	S*IVAPUR	1
MILANAKE	1	LAK*ANAFU*	1	VA*RTA*	1	VID*A*N	1
PARIQAD	1	H*I*KRIQR*	1	VA*JAPEYI*	1	P*AP*U*V*D	1
GLU*KOJ	1	NAMU*NA*	1	SANASANI*	1	DI*	0

App-(H)

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C*****************************************************
CKLATT FORMANT CASCADE/PARALLEL SYNTHESIZER IMPLEMENTED ON VAX-11/780
C*****************************************************
      IMPLICIT INTEGER (A-Z)
      REAL DB,DBLPNT,EPSLON,XMAXWA
C  EACH OF THE FOLLOWING VARIABLE HOLDS UP TO 5 ASSCII CHERACTERS
      REAL QUIT,NAMEV,NAMES(39),NAMEX(39)
      REAL DUMMY
      DIMENSION MAXVAL(39),MINVAL(39),VALUES(39),IPAR(39)
      DIMENSION VARPAR(39),DOC(39),DOCSAV(39),D(5200),IWAVE(5200)
      DIMENSION COEFFC(50)
      COMMON /PARS/IPAR
      COMMON /COEFS/COEFFIC
      EQUIVALENCE (D(1),IWAVE(1))
C CHARACTER SYMBOL FOR EACH OF 39 CONTROL PARAMETER VALUES
      DATA NAMES/'AV','AF','AH','AVS','F0','F1','F2','F3','F4','FNZ',
     1'A1','A2','A3','A4','A5','A6','AB','B1','B2','B3','SW',
     1'FGP','BGP','FG2','BG2','B4','F5','B5','F6','B6','FNP',
     1'B1P','B1Z','BGS','SR','NFS','GO','DFC'/
C  MAXIMUM POSSIBLE VALUE OF EACH 39 CONTROL PARAMETER
      DATA MAXVAL/80,80,80,80,500,900,2500,3500,4500,700,80,80,80
     1,80,80,80,80,80,1000,1500,2000,1,600,2000,5000,10000,
     13000,4900,4000,4999,2000,500,500,500,1000,20000,200,80,6/

C  MINIMUM POSSIBLE VALUES FOR EACH OF 39 CONTROL PARAMETERS
      DATA MINVAL/0,0,0,0,0,150,500,1300,2500,200
     1,0,0,0,0,0,0,0,0,40,40
     1,40,0,0,100,0,100,100,3500,150,4000
     1,200,200,50,50,100,5000,1,0,4/
C  DETERMINATION OF VARIABLE(=1,OR=2) OR CONSTANT(=0)
C  PARAMETERS
C  (PROGRAM SETS=2 IF ACTUALLY VARRIED)
      DATA VARPAR/1,1,1,1,1,1,1,1,1,1,0,0,1,1,1,1,1
     1,1,1,1,1,0,0,0,0,0,0,1,0,0,0,0,0,0,0,0,0,0,0/
C
      DATA VALUES/0,0,0,0,0,450,1450,2450,3300,250,0,0,0,0,0,0,0,0,
     150,70,110,0,0,100,1500,6000,250,3750,200,4900,1000,250,100,
     1100,200,10000,50,47,5/
C  SIZE OF PARAMETER AND WAVEFORM ARRAYS THAT RESIDE IN CORE
      DATA WSIZE/5200/
C
C  NAME OF SOME RESPONSE CHERACTERS
      DATA QUIT,QUIT1,YES,NO,VAR,CON/'Q','Q','Y','N','V','C'/
1000  WRITE(5,1010)
1010  FORMAT('AVOEESH CASCADE/PARALLEL FORMAT SYNTHESIZER /')
C
CC
C  SEE IF FILE PARM.DOC EXISTS;IF SO,READ CONFIGRATION
      OPEN(UNIT=1,NAME='PARAM.DOC',TYPE='OLD',ERR=1140)
      DOPAR=1
      WRITE(5,1020)
1020  FORMAT(' READING INITIAL SYNTHESIZER CONFIGRATION FROM FILE
     1 ''PARAM.DOC''/)
      DO 1060 M=1,13
      N=M+13
      N1=M+26
      READ(1,2617) DUMMY,NAMES(M),VARPAR(M),VALUES(M)
      READ(1,2617) DUMMY,NAMES(N),VARPAR(N),VALUES(N)
      READ(1,2617) DUMMY,NAMES(N1),VARPAR(N1),VALUES(N1)
1060  CONTINUE
C
CC    CHANGE CONFIGRATION,CHANGE WHICH PARS ARE VARIABLE
C
1140  WRITE(5,1160)
1160  FORMAT(' PRINT AND/OR CHANGE CONFIGRATION(Y,Q):'$)
1170  READ(5,1180,ERR=1140) ANSWER
1180  FORMAT(A1)
1185  IF(ANSWER.EQ.QUIT1)GO TO 1740
      GO TO 1685
1190  WRITE(5,1220)
1220  FORMAT(/' NAME OF PARAMETER TO BECOME VAR OR CON(QUIT='Q'):'$)
      READ(5,1260,ERR=1190) NAMEV
1260  FORMAT(A3)
1270  IF(NAMEV.EQ.QUIT)GO TO 1500
C
      DO 1280 N=1,39
      IF(NAMEV.EQ.NAMES(N)) GO TO 1320
1280  CONTINUE
      WRITE(5,1300) NAMEV
1300  FORMAT('  ',A5,'TYPING ERROR,TRY AGAI ')
      WRITE(5,1555)(NAMES(M),M=1,39)
      GO TO 1190
1320  MODPAR=YES
      IF(N.LT.35) GO TO 1330
      WRITE(5,1325) NAMES(N)
1325  FORMAT(' PARAMETER',A5,'CANNOT BE MADE VARIABLE')
      GO TO 1190
1330  IF(VARPAR(N).NE.0) GO TO 1380
```

```
      WRITE(5,1360) NAMEV
1360  FORMAT(' ','A3','IS NOW A VARIABLE')
      GO TO 1190
1380  IF(VARPAR(N).NE.2) GO TO 1390
C  IF VARIED IN PREVIOUS SYNTH ATTEMPT, CAN'T MAKE IN TO
C  A CONSTANT
      WRITE(5,1385) NAMEV
1385  FORMAT(' ','A3','CAN NO LONGER BE MADE A CONSTANT')
      GO TO 1190
1390  VARPAR(N)=0
1400  WRITE(5,1420) NAMEV
1420  FORMAT(' ',A3,'IS NO. A CONSTANT')
1440  FORMAT('DONE')
      GO TO 1190
C  CHANGE DEFAULT VALUE FOR A PARAMETER
1500  WRITE(5,1520)
1520  FORMAT(' NAME OF PARAMETER WHOSE DEFAULT VALUE TO BE CHANGED
     1(QUIT='Q'):')
      READ(5,1260,ERR=1550)NAMEV
C
1530  IF(NAMEV.EQ.QUIT) GO TO 1740
      DO 1540 N=1,39
      IF(NAMEV.EQ.NAMES(N)) GO TO 1560
1540  CONTINUE
1550  WRITE(5,1300)NAMEV
      WRITE(5,1555)(NAMES(N),N=1,39)
1555  FORMAT(' PARS=',13A4)
      GO TO 1500
1560  IF((N.NE.36).AND.(N.NE.37))GO TO 1570
C  DON'T CHANGE WS OR SR IF READING FROM PARAMETER FILE
      IF(OPENPA.EQ.0) GO TO 1570
      WRITE(5,1565)NAMEV
1565  FORMAT(' CANNOT CHANGE THE VALUE OF ',A3,' ANYMORE')
      GO TO 1500
1570  WRITE(5,1580) NAMEV
1580  FORMAT(' NEW DEFAULT VALUE FOR', A3,'=')
      READ(5,1900,ERR=1560)VALUE
C
      IF(VALUE.LE.MAXVAL(N)) GO TO 1620
      WRITE(5,1600) VALUE,MAXVAL(N)
1600  FORMAT(' ',I6,'EXEED MAXIMUM OF',I5,'TRY AGAIN')
      GO TO 1560
1620  IF(VALUE.GE.MINVAL(N)) GO TO 1660
      WRITE(5,1640) VALUE,MINVAL(N)
1640  FORMAT(' ',I5,'LESS THAN MINIMUM='I5',TRY AGAIN')
      GO TO 1560
1660  MODPAR=YES
      VALUES(N)=VALUE
      WRITE(5,1440)
      GO TO 1500
C
C  PRINT CONFIGRATION
C
C
C
1680  IF(MODPAR.EQ.NO) GO TO 1740
1685  WRITE(5,1690)
1690  FORMAT(' CURRENT CONFIGRATION(NAME,VAR/CON, DEFAULT VALUE:')
      DO 1720 N=1,13
      N=N+13
      N1=N+26
      WRITE(5,1700) N,NAMES(N),VARPAR(N),VALUES(N),N,NAMES(N)
     1,VARPAR(N),VALUES(N),N1,NAMES(N1),VARPAR(N1),VALUES(N1)
1700  FORMAT(' ',I2,' ',A4,I2,I6,2(' ',I2,' ',A4,I2,I6))
1720  CONTINUE
      GO TO 1190
C
C  COUNT NUMBER OF VARIABLE PARAMETERS,NAVAR,
C  AND PLACE NAMES IN NAMEX(NAVR)
1740  NSAMP=VALUES(37)
      DENOM=VALUES(36)/10
      DELTAT=(NSAMP*100)/DENOM
      NVAR=0
      DO 1760 N=1,39
      IF(VARPAR(N).EQ.0) GO TO 1760
      NVAR=NVAR+1
      LOC(NVAR)=N
      NAMEX(NVAR)=NAMES(N)
1760  CONTINUE
      IF(NVAR.GT.0) GO TO 1800
      WRITE(5,1780)
1780  FORMAT(' ILLEGAL CONFIG,NO VARIABLE PRAMS, TRY AGAIN')
      GO TO 1680
1800  MAXDUR=((WSIZE/NSAMP)*DELTAT)-20
      PRINT*,MAXDUR
      WRITE(5,1820)NVAR
C
1820  FORMAT(/' THERE ARE',I2,'VARIABLE PARAMETER')
      WRITE(5,1840) DELTAT
```

```
1840     FORMAT(' PARAMETERS ARE TO BE SPCIFIED EVERY',I3,'MSEC')
1860     IF(OPENPA.EQ.0) GO TO 1870
         READ(1,2625)VALUE
         WRITE(5,1867) VALUE
1867     FORMAT(' LENGTH OF UTTERANCE IN MSEC=',I5)
         GO TO 1910
1870     WRITE(5,1880) MAXDUR
1880     FORMAT(' DESIRED LENGTH OF UTTERANCE IN MSEC(MAX=',I4,'):'$)
1885     READ(5,1900,ERR=1860)VALUE
1900     FORMAT(I5)
1910     IF(VALUE.GE.DELTAT) GO TO 1920
         WRITE(5,1300) NAMEV
         GO TO 1860
1920     IF(VALUE.LE.MAXDUR) GO TO 1960
         WRITE(5,1940)VALUE,MAXDUR
1940     FORMAT('  ',I4,'ILLEGEAL,MAXIMUM DURATION=',I4,',TRY AGAIN')
         GO TO 1860
1960     UTTDUR=VALUE
C
C
C     INSERT DEFAULT VALUES INTO PARMETER TRACKS
         NSAMT1=((UTTDUR+20)/DELTAT)-1
         DO 2000 M=0,NSAMT1
         M1=M*NSAMP
         M2=0
         DO 1980 N=1,39
         IF(VARPAR(N).EQ.0) GO TO 1980
         M2=M2+1
         D(M1+M2)=VALUES(N)
1980     CONTINUE
2000     CONTINUE
         WRITE(5,2020)
C
2020     FORMAT(/' DEFAULT VALUES INSERTED IN PARAMETER TRACKS')
C
C
C  PUT VARIABLE DATA FROM FILE PARAM.DOC IN TO PARAMETER
C  TRACKS
2040     IF(OPENPA.EQ.0) GO TO 2050
         WRITE(5,2041)
2041     FORMAT(' READING VARIABL PARAMETERIC DATA FROM FILE
         1 ''PARAM.DOC''')
         READ(1,2043)DUMMY,(DUMMY,M=1,NVAR1)
2043     FORMAT(27A5)
         NVAR1=0
         DO 2045 N=1,NVAR
         IF(VARPAR(LOC(N)).NE.2) GO TO 2045
         NVAR1=NVAR1+1
         PRINT*,'NVAR1',NVAR1
         LOCSAV(NVAR1)=N
2045     CONTINUE
         IF(NVAR1.GT.0) GO TO 2047
         WRITE(5,1780)
         STOP
2047     IF(NVAR1.GT.26) NVAR1=26
         NSAM11=(UTTDUR/DELTAT)+1
         DO 2048 M=0,NSAMT1
         M1=M*NSAMP
         READ(1,2660)TIME,(D(LOCSAV(N)+M1),N=1,NVAR1)
2048     CONTINUE
         CLOSE(UNIT=1)
C
C  ACCEPT MODIFICATIO, TO PARAMETER TRACKS
2050     OLDTIM=0
         SEIPNT=0
         MAXD1=UTTDUR-DELTAT
         WRITE(5,2060)
C
2060     FORMAT(/' NAME OF PARAMETER TRACK TO BE NOTITED
         1(QUIT=''Q''):'$)
2065     READ(5,1260,ERR=2090)NAMEV
2075     IF(NAMEV.EQ.QUIT) GO TO 2600
         DO 2080 N=1,NVAR
         IF(NAMEV.EQ.NAMEX(N)) GO TO 2120
2080     CONTINUE
         WRITE(5,1300)NAMEV
2090     WRITE(5,2100)(NAMEX(N),N=1,NVAR)
2100     FORMAT(' VARIABLE PARS=',1044)
         GO TO 2050
2120     CONTINUE
         VARPAR(LOC(N))=2
         MAXV=MAXVAL(LOC(N))
         MINV=MINVAL(LOC(N))
2180     WRITE(5,2200)
2200     FORMAT('T='$)
2220     READ(5,2240,ERR=2550)TIME
2240     FORMAT(I3)
C
C  QUIT DRAWING CURRENNT PARAMETER CONTOUR
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```
      IF((TIME.EQ.0).AND.(SETPNT.EQ.YES)) GO TO 2050
      IF(TIME.LT.0) GO TO 2050
C  MAKE SURE LEGAL TIME
      IF(TIME.GE.OLDTIM) GO TO 2260
2255  WRITE(5,2260)TIME,OLDTIM
2260  FORMAT(' ILLEGAL TIME=',I3,',LESS THEN OLDTIM='I3)
      GO TO 2180
2280  IF(TIME.LE.MAXD1)GO TO 2320
      WRITE(5,2300) TIME,MAXD1
C
2300  FORMAT(' ILLEGAL TIME=',I3,'GREATER THEN MAX=',I3)
      GO TO 2180
2320  NPTS=TIME/DELTAT
      TIMF=FPTS*DELTAT
      POINTR=((NPTS)*NSAMP)+
2330  WRITE(5,2340)
2340  FOR AT('V=',$)
2345   WRITE(5,1900,ERR=2550) VALUE
C
C  SEE IF LEGAL VALUE
2360  IF(VALUE.LE.MAXV) GO TO 2400
2370  WRITE(5,2371) MINV,MAXV
2371  FORMAT('VMIN=',I5,',VMAX=',I5)
      GO TO 2330
2400  IF(VALUE.GE.MINV) GO TO 2420
      GO TO 2370
2420  IF((SETPNT.EQ.YES).AND.(TIME.GE.(OLDTIM+DELTAT
      1))) GO TO 2480
C
C  SET A POINT
      D(POINTR)=VALUE
2460  OLDTIM=TIME
      OLDVAL=VALUE
      STEPNT=YES
      GO TO 2180
C
C  DRAW A LINE
2480  NPTS=(TIME-OLDTIM)/DELTAT
      DVALUE=VALUE-OLDVAL
      EPSLON=0.1
      IF(DVALUE.LT.0) EPSLON=-EPSLON
      TIME1=OLDTIM/DELTAT
C
      DO 2500 N=1,NPTS
      DBLPNT=FLOAT(N)*FLOAT(DVALUE)
      DBPLNT=DBPLNT/FLOAT(NPTS)
      VALUE2=OLDVAL+IFIX(DBLPNT+EPSLON)
      POINTR=((TIME1+N)*NSAMP)+N
2500  D(POINTR)=VALUE2
      GO TO 2460
C
C  UNRECOVERABLE I/O ERROR,SAVE PARAMETERS AND QUIT
C
2550  WRITE(5,2560)
2560  FORMAT(' UNRECOVERABLE TYPING ERROR,SAVE PARAMETERS')
C
C  MAKE FILE OF PARAMETER VALUE VS TIME THAT CAN BE LISTED
C  ON LINE PRINTER
C
2600  CONTINUE
2610  OPEN(UNIT=1,NAME='PARAM.LOC',TYPE='NEW',ERR=2600)
      DO 2620 N=1,13
      N1=N+13
      N1=N+26
      DUMMY='
      WRITE(1,2617) DUMMY,NAMES(N),VARPAR(N),VALUES(N),
     1  DUMMY,NAMES(N),VARPAR(N),VALUES(N),
     1  DUMMY,NAMES(N1),VARPAR(N1),VALUES(N1)
2617  FORMAT(' ',A5,A3,I2,I5)
2620  CONTINUE
      WRITE(1,2625)UTTDUR
2625  FORMAT(' ',I3)
      NVAR1=0
      DO 2630 N=1,NVAR
      IF(VARPAR(LOC(N)).NE.2) GO TO 2630
C
C
      NVAR1=NVAR1+1
      LOCSAV(NVAR1)=N
2630  CONTINUE
      IF(NVAR1.GT.0)GO TO 2640
      WRITE(5,1780)
      GO TO 2900
2640  IF(NVAR1.GT.26)NVAR1=26
      WRITE(1,2650)(NAMEX(LOCSAV(M)),M=1,NVAR1)
2650  FORMAT('    ',26A5)
```

```
      M1=M*NSAMP
      WRITE(1,2660)TIME,(D(LOCSAV(N)+M1),N=1,NVAR1)
2660  FORMAT(I3,26I5)
2665  CONTINUE
      CLOSE(UNIT=1)
      WRITE(5,2667)
2667  FORMAT(' PARAMETER FILE ''PARAM.DOC''SAVED')
C
C  SET ALL PARAMETERS IN ARRAY IPAR TO DEFAULT VALUES
C  SET ALL PARAMETES IN ARRAY IPAR TO DEFAULT VALUES
C
      WRITE(5,2675)

2675  FORMAT(/'BEGIN WAVEFORM GENERATION')
2676  DO 2680 N=1,39
2680  IPAR(N)=VALUES(N)
C
C  INITIALIZE SYNTHESIZER
C
      MAX A=-1
      XMAXWA=-1
C
CCC   MAIN SYNTHESIZER LOOP,PUT WAVE FORM IN IWAVE(WISIZE1)
CCC
C  ADD 20 SEC TO DURATION TO INSURE SIGNAL WILL DECAY TO ZERO
C
      NPTS=(OUTDUR+20)/DELTAT
      TIME1=0
      WSIZE1=1
      DO 2740 M=1,NPTS
      POINTR=(M-1)*NSAMP
      DO 2700 N=1,NVAR
2700  IPAR(LOC(N))=D(POINTR+N)
      CALL PARCOE(MAXWA)
      CALL COFWAV(IWAVE(WSIZE1),XMAXWA)
2740  WSIZE1=WSIZE1+NSAMP
C
C  MAKE SURE SIGNAL IS LESS THAN OR EQUAL TO  0.0 DB
      DB=20.0*ALOG10(XMAXWA/32767)
      WRITE(5,2760) DB
2760  FORMAT('PEAK SIGNAL LEVAL
     1 IN SYNTHETIC WAVEFORM=',F6.1,'DB')
C
C  SAVE WAVEFORM FILE IWAVE(WSIZE1) ON DISK
C
      OPEN(UNIT=1,NAME='IWAVE.I6',TYPE='NEW',ERR=2800)
      WRITE(1,2775) WSIZE1
2775  FORMAT(I5)
      WRITE(1,2785)(IWAVE(M),M=1,WSIZE1)
2785  FORMAT(20I6)
      CLOSE(UNIT=1)
      WRITE(5,2795)
2795  FORMAT(/'WAVE FORM FILE ''IWAVE.I6''SAVED'//)
      GO TO 2900
2800  WRITE(5,2805)
2805  FORMAT('DISK ACCESS ERROR DURING ATTEMT TO SAVE WAVEFORM')
2900  STOP
      END
C     ================================================
C     ================================================
C     END OF  MAIN PROG
C     ================================================
C     THISE PART CONTAIN SUBROUTINE OF THE PROGRAM.
C     ================================================
C  PARACOE.FOR   SUAD
C
C  ''PARAM-TO-COEF''TRANSFORMATION SUBROUTINE
C
C     THISE PROGRAM CONVERTS SYNTHESIZER CONTROL PARAMETER FROM
C     ARRAY I(39) INTO DIFFERENCE EQUATION CONSTANT FOR SYNTHESIZER
C     HARDWARE STORED IN ARRAY C(50)
C
      SUBROUTINE PARCOE(INITPC)
C INITPC INITIALIZER THIS ROUTINE IF=-1
      REAL IMPULS
      DIMENSION I(39),NORSCA(12),NORCOR(10),C(50)
C  INPUT PARAMETER VALUES (CONSTANT & VARIABLE)PASSED
C  THROUG I
      COMMON/PARS/I
      COMMON/COEFS/C
      COMMON/PIXX/PIT,TWOPIT
C  COEFFICIENT VALUES IN C(50) ARA REAL
      EQUIVALENCE (C(1),IMPULS),(C(2),SINAMP),(C(3),AFF),(C(4),AHH),
     1(C(5),A1P),(C(6),A2P),(C(7),A3P),(C(8),A4P),(C(9),A5P),
     1(C(10),A6P)
      EQUIVALENCE(C(11),ABP),(C(12),APP),(C(13),AGP),
     1(C(14),BGP),(C(15),CGP),(C(16),AGZ),(C(17),BGZ),(C(18),CGZ),
     1(C(19),AGS),(C(20),BGS),(C(21),CGS)
      EQUIVALENCE(C(22),A1),(C(23),B1),(C(24),C1)
```

```
      EQUIVALENCE(C(25),A2),(C(26),B2),(C(27),C2)
      EQUIVALENCE(C(28),A3),(C(29),B3),(C(30),C3)
      EQUIVALENCE(C(31),A4),(C(32),B4),(C(33),C4)
      EQUIVALENCE(C(34),A5),(C(35),B5),(C(36),C5)
      EQUIVALENCE(C(37),A6),(C(38),B6),(C(39),C6)
      EQUIVALENCE(C(40),ANP),(C(41),BNP),(C(42),CNP)
      EQUIVALENCE(C(43),ANZ),(C(44),BNZ),(C(45),CNZ)
C
CC    ================================================================
      EQUIVALENCE (C(46),PLSTEP)
C  NAME OF INPUT CONTROL PARAMETER
      EQUIVALENCE (I(1),NAV),(I(2),NNAF),(I(3),NNAH),(I(4),NNAVS),
     1(I(5),NNF0),(I(6),NNF1),(I(7),NNF2),(I(8),NNF3),
     1(I(9),NNF4),(I(10),NNF5),(I(11),NNA1),(I(12),NNA1),
     1(I(13),NNA2),(I(14),NNA3),(I(15),NNA4),(I(16),NNA5),
     1(I(17),NNA6),(I(18),NNAB),(I(19),NNB1),(I(20),NNB2),
     1(I(21),NNB3),(I(22),NNSW),(I(23),NNFGP),(I(24),NNBGP),
     1(I(25),NNFGZ)
      EQUIVALENCE(I(26),NNBGZ),(I(27),NNB4),(I(28),NNF5),(I(29),NNB5),
     1(I(30),NNF6),(I(31),NNB6),(I(32),NNFNP),(I(33),NNBNP),
     1(I(34),NNBGZ),(I(35),NNPGS),(I(36),NNSR),(I(37),NNNWS),
     1(I(38),NNG0),(I(39),NNFC)
C CONSTANTS NEEDED BY SUBROUTIN SET ABC
      DATA PI/3.14159265/
C
CC  SCALE FACTOR IN DB FOR GENERAL ADJUSTMENT TO
C       A1,A2,A3,A4,A5,A6,AB,AV,AH,AF,AVS
      DATA DBSCA/-58,-65,-73,-78,-79,-80,-58,-84,-72,-102,-72,-44/
C  INCREMENT IN DB TO FORMAT AMPLITUDES OF PARALLEL BRANCH
C  IF FORMANT FREQENCY DIFFERENCE 50,100,150,.....HZ
      DATA NDBCOR/10,9,8,7,6,5,4,3,2,1*/
C  PRINT INPUT PAR VALUES AT T=NTIMPR
C  OR AT ALL TIMES IF NTIMPR=0
      DATA NTIMPR,NPPBEG,NPPEND/-1,1,39/
C
CCC
CCC
CC      INTIALIZE SYSNTHESIZER BEFOR COMPUTING WAVE FORM
CC      CHUNK IF ARG.LT.0
100     IF(INITPC.GE.0)GO TO 130
        INITPC=0
C  SET CUMULATIVE TIME COUNTER TO ZERO
        NTIMEP=0
        NAFLAS=0
C       ================================================================
C
CC    COMPUTE   SAMPILING PERIOD T(ALL CONSTANT CONTROL
C PARAMETERS MUST BE SET BEFOR CALLING INIT)
        SAMRAT=NNSR
        T=1./SAMRAT
        PIT=PI*T
        TWOPIT=2.*PIT
        NTIMED=(NNSS*100)/(NNSR/10)
C  CONVERT INTERMEDIATELY INTEGER PARAMS TO REAL COEFICIENTS
        C(48)=NNNWS
        C(49)=NNSR
        C(50)=NNFFC
110     CONTINUE
C
C
CC  UP DATE ALL COFFICIENTS OF HARDWARE SYNTHESIZER
C  COMPUTE PARALELL BRANCH AMPLITUED CORRECTION TO
C  F2 DUE TO F1
130     DELF1=FLOAT(NNF1)/500.
        A2COR=DELF1*DELF1
C  COMPUTE AMPLITUDE CORRECTION TO F3_5 DUE TO F1 AND F2
        DELF2=FLOAT(NNF2)/1500.
        A2SQRT=DELF2*DELF2
        A3COR=A2COR*A2SQRT
C  TAKE IN TO ACCOUNT FIRST DIFF OF GLOTTAL WAVE FOR F2
        A2COR=A2COR/DELF2
C  COMPUTE AMPLITUED CORRECTION DUE TO PROXIMITY
C  OF 2 FORMANTS
        N12COR=0
        N23COR=0
        N34COR=0
        NF21=NNF2-NNF1
C
        IF(NF21.LT.50) GO TO 135
        IF(NF21.LT.550) N12COR=NDBCOR(NF21/50)
        NF32=NNF3-NNF2-50
        IF(NF32.LT.50) GO TO 135
        IF (NF32.LT.550) N23COR=NDBCOR(NF32/50)
        NF43=NNF4-NNF3-150
        IF(NF43.LT.50) GO TO 135
        IF(NF43.LT.550) N34COR=NDBCOR(NF43/50)
C  PRINT INPUT PARAMETERS IF NTIMPR SET TO ZERO OR
C  TO ASPECIFIC TIME
        IF(NTIMPR.EQ.0) GO TO 135
```

```
      IF(NTIMPR.NE.NTIMEP) GO TO 146
135   WRITE(5,140) NTIMEP
140   FORMAT('INPUT PARS AT T=',I4,'MS')
      WRITE(5,141)(I(NPP),NPP=NPPBEG,NPPEND)
141   FORMAT(' ',13I5)
      WRITE(5,142)
142   FORMAT(' ')
145   NPAR=1
146   NTIMEP=NTIMEP+NTIMED
C  SET AMPLITUED OF VOICING
      NDBAV=NNG0+NAAV+NDBSCA(9)
      IMPULS=GETAMP(NDBAV)
C  AMPLITUED OF ASPIRATION
150   NDBAH=NNG0+NAAH+NDBSCA(10)
      AAH=GETAMP(NDBAH)
C  AMPLITUED OF FRICATION
C     (IN ALL PARALLEL CONFIGRATION,AF=MAX(AF,AH)
      IF((NNAH.GT.NNAF).AND.(NRSW.EQ.1)) NNAF=NNAH
      NDBAF=NNG0+NAAF+NDBSCA(11)
      AFF=GETAMP(NDBAF)
C     A V O I E S H     G U P T A     PAGE 17
C     ADD A SET TO WAVE FORM AT A PLOSIVE RELEASE
      PLSTEP=0.
      IF(NNAF-NAFLAS.LT.49) GO TO 151
      PLSTEP=GETAMP(NNG0+NDBSCA(11)+44)
151   NAFLAS=NNAF
C     AMPLITUED OF QUASI_SINUSODIAL VOKING SOURCE
      SINAMP=10.*GETAMP(NDBAVS)
C     SET AMPLITUED OF PARALLEL FORMANTS A1 THRU A6
      NDB=NNA1+N12COR+NDBSCA(1)
      A1P=GETAMP(NDB)
      NDB=NNA2+N12COR+N12COR+N23COR+NDBSCA(2)
      A2P=A2COR*GETAMP(NDB)
      NDB=NNA3+N23COR+N23COR+N34COR+NDBSCA(3)
      A3P=A3COR*GETAMP(NDB)
      NDB=NNA4+N34COR+N34COR+NDBSCA(4)
      A4P=A3COR*GETAMP(NDB)
      NDB=NNA5+NDBSCA(5)
      A5P=A3COR*GETAMP(NDB)
      NDB=NNA6+NDBSCA(6)
      A6P=A3COR*GETAMP(NDB)
C     SET AMPLITUED OF PARALLEL NASAL FORMATNT
      NDB=NNAN+NDBSCA(7)
      ANPP=GETAMP(NDB)
C     SET AMPLITUED OF BY PASS PATH FRICTIN TRACT
      NDB=NNAB+NDBSCA(8)
      ABP=GETAMP(NDB)
C     RESET DIFFERENCE EQUATION CONSTANT FOR RESNATORS
230   CALL SETABC(NNF1,NNB1,A1,B1,C1)
      CALL SETABC(NNF2,NNB2,A2,B2,C2)
      CALL SETABC(NNF3,NNB3,A3,B3,C3)
      CALL SETABC(NNF4,NNB4,A4,B4,C4)
      CALL SETABC(NNF5,NNB5,A5,B5,C5)
      CALL SETABC(NNF6,NNB6,A6,B6,C6)
C
      CALL SETABC(NNFNP,NNBNP,ANP,BNP,CNP)
C     AND FOR NASAL ANTIRESONATOR
      NNFNZ=-NNFNZ
      IF(NNFNZ.GE.0) NNFNZ=-1
      CALL SETABC(NNFNZ,NNBNZ,ANZ,BNZ,CNZ)
C     AND FOR GLOTTAL RESONATOR AND ANTIRESONATOR
      NPULSE=1
      IF(NNF0.LE.0) GO TO 245
C     ISSUE NO PULSE IF NNAV AND NNAVS BOTH.LE.0
      IF((NNAV.LE.0).AND.(NNAVS.LE.0)) GO TO 245
C     WAVEFORM MORE SINUSOIDAL AT HIGH FUNDAMENTAL
C     FREQUENCY
      NXBGP=(NNBGP/NNF0)*100
      CALL SETABC(NNFGP,NXBGP,AGP,BGP,CGP)
      CALL SETABC(0,NNBGS,AGS,BGS,CGS)
      NNFGZ=-NNFGZ
      IF(NNFGZ.GE.0) NNFGZ=-1
      CALL SETABC(NNFGZ,NNBGZ,AGZ,BGZ,CGZ)
C     SET AGAIN TO CONSTANT IN MID FREQUENCY REGION FOR RGP
      AGP=.007
C     DO NOT LET FO DROP BELOW 40HZ
      IF(NNF0.LT.40) NNF0=40
C     MAKE AMPLITUED OF IMPULSE INCREASE WITH INCREASING FO
C
      IMPULS=IMPULS*(NNF0/1000.0)
C     NUMBER OF SAMPLES BEFOR A NEW GLOTTAL PULSE MAY BE GENERATED
      NPULSN=NNSR/NNF0
245   CONTINUE
C     CONVERT INHERENTLY INTEGER PARAMS TO REAL COEFFICIENTS
      C(47)=NPULSN
      RETURN
      END
C     COEWAVE FOR SUAD
C     COEFFICIENT TO WAVE TRANSFORMATION SUBROUTINE
```

```
C           (FOR 16 BIT PDP-11 COMPUTER)
C       SIMULATION OF THE HARDWARE QUAD SYNTHESIZER
C       TAKE 50 COEFFICIENT FROM COMMON ARRAY C AND
C
        SUBROUTINE COEWAV(IWAVE,OUTMA)
C       IWAVE IS AN ARRAY IN WHICH WAVEFORM SAMPLES ARE
C       PLACED LEFT JUSTIFIED IN A 36 BIT WORD
C       OUTMA IS RETURN ARG INDICATING MAXAMPSOL,VALUE
C       OF WAVE IF CALLING PROGRAM SETS TO -1,COEWAVE IS INTIALIZED
        REAL NOISE INPUTS,INPUT,IMPULS
        INTEGER WAVMA,WAVMAX
        DIMENSION IWAVE(1),C(50)
        COMMON/COEFS/C
C       COEFFICIENT VALUES IN C(50) ARE REAL
        EQUIVALENCE(C(1),IMPULS),(C(2),SIMAMP),(C(3),AFRICI)
        EQUIVALENCE(C(4),AASPI),(C(5),A1PAR),(C(6),A2PAR)
        EQUIVALENCE(C(7),A3PAR),(C(8),A4PAR),(C(9),A5PAR)
        EQUIVALENCE(C(10),A6PAR),(C(11),ABPAR),(C(12),ANPAR)
        EQUIVALENCE(C(13),AGP),(C(14),BGP),(C(15),CGP)
        EQUIVALENCE(C(16),AGZ),(C(17),BGZ),(C(18),CGZ)
        EQUIVALENCE(C(19),AGS),(C(20),BGS),(C(21),CGS)
        EQUIVALENCE(C(22),A1),(C(23),B1),(C(24),C1)
        EQUIVALENCE(C(25),A2),(C(26),B2),(C(27),C2)
        EQUIVALENCE(C(28),A3),(C(29),B3),(C(30),C3)
        EQUIVALENCE(C(31),A4),(C(32),B4),(C(33),C4)
        EQUIVALENCE(C(34),A5),(C(35),B5),(C(36),C5)
        EQUIVALENCE(C(37),A6),(C(38),B6),(C(39),C6)
        EQUIVALENCE(C(40),ANP),(C(41),BNP),(C(42),CNP)
        EQUIVALENCE(C(43),ANZ),(C(44),BNZ),(C(45),CNZ)
        EQUIVALENCE(C(46),PLSTEP)

C       MAXIMUM VALUE FOR A WAVE FORM SAMPLES (LEFT-JUSTIFY IN 36 BIT
C       WORD)
        DATA WAVMA,WAVMAX/32767,-32767/
C
C       INITIALIZE COEWAVE IF OUTMA=-1
C       ZERO MEMORY REGISTER IN ALL RESONATORS
        IF(OUTMA.GE.0) GO TO 250
249.    YL11P=0.
        YL12P=0.
        YL21P=0.
        YL22P=0.
        YL31P=0.
        YL32P=0.
        YL41P=0.
        YL42P=0.
        YL51P=0.
        YL52P=0.
        YL61P=0.
        YL62P=0.
        YLNP1=0.
        YLNP2=0.
        YL11C=0.
        YL12C=0.
        YL21C=0.
        YL22C=0.
        YL31C=0.
        YL32C=0.
        YL41C=0.
        YL42C=0.
        YL51C=0.
        YL52C=0.
        YL61C=0.
        YL62C=0.
        YLNP1C=0.
        YLNP2C=0.
        YLNZ1C=0.
        YLNZ2C=0.
        YLGP1=0.
        YLGP2=0.
        YLGS1=0.
        YLGS2=0.
        YLGS3=0.
        YLGS4=0.
        YLGZ1=0.
        YLGZ2=0.
C       ZERO ALL OTHER MEMORY REGISTERS
        NPULSE=1
        MPULSE=0.
        UGLOTX=0
        UGLOTL=0.
        OUTMA=0.
        AFRIC=0.
        STEP=0.
        AASPIR=0.
C
C       GENERATE NNXWS SAMPLES OF OUTPUT WAVE FORM
250     CONTINUE
C       TRANSLATE SOME COEFFICIENT TO INTEGER
```

```
      NPULSN=C(47)
      NNXWS=C(48)
      NXSW=C(49)
      NNXFC=C(50)
      XNSAMI=1.0/FLOAT(NNXWS)
C     DELTA AMPLITUDE OF ASPIRATION
      DAHH=(AASPI-AASPIR)*XNSAMI
C     DELTA AMPLITUDE OF FRICTION
      DAFF=(AFRICI-AFRIC)*XNSAMI

C     MAIN LOOP
      DO 530 NTIME=1,NNXWS
C     GENERATE NEW GLOTTAL PULSE IF PERIOD COUNTER EXCEEDED
      NPULSE=NPULSE-1
      IF(NPULSE.GT.0) GO TO 260
C     AND IF NPULSE IS GT THEN 1(IE.IF FC>0 AND AV+AVS>0)
      IF (NPULSN.LE.1) GO TO 260
C     RESET PULSE COUNTER
      NPULSE=NPULSN
C     PULSE COUNTER FOR MODULATED NOISE
      MPULSE=NPULSE/2
C     SET AMPLITUDE NORMAL VOICING IMPULSE
      INPUT=IMPULS
C     AMPLITUDE OF QUASI SINUSOIDAL VOICING
      INPUTS=SIMAMP
      GO TO 275
C     SET INPUT TO ZERO BETWEEN GLOTTAL IMPULSES
260   INPUT=0.
      INPUTS=0.
C     RESONATOR RGP:
275   YGP=AGP*INPUT+BGP*YLGP1+CGP*YLGP2
      YLGP2=YLGP1
      YLGP1=YGP
C     GLOTTAL ZERO PAIR RGZ:
290   YGZ=AGZ*YGP+BGZ*YLGZ1+CGZ*YLGZ2
      YLGZ2=YLGZ1
      YLGZ1=YGP
C     GLOTTAL ZERO PAIR RGZ:
C     QUASI SINUSOIDAL VOICING PRODUCED BY IMPULSE
C     INTO RGP AND RGS
      YGS=INPUTS*AGS+BGS*YLGS1+CGS*YLGS2
      YLGS2=YLGS1
      YLGS1=YGS
      YGS=AGP*YGS+BGP*YLGS3+CGP*YLGS4
      YLGS4=YLGS3
      YLGS3=YGS
C
C     GLOTTAL VOLUME VELOCITY IS THE SUM OF NORMAL AND QUASI
C
C     SINUSOIDAL  VOICING
      UGLOT2=YGZ+YGS
C     RADIATION CHARACTERSTICS ISA ZERO AT THE ORIGIN
      UGLOT=UGLOT2-UGLOTX
      UGLOTX=UGLOT2
C
C     TURBULANCE NOISE OF ASPIRATION AND FRICTION
C     GENERATE RANDOM PRODUCE UNIFORM
370   NOISE=0.
C     MAKE PSEUDO -GAUSSIAN
      DO 371 IRANDX=1,16
371   NOISE =NOISE+RAN(IRAN1,IRAN2)
C     SUBTRACT OF DC
      NOISE=NOISE-8.
C     MODULATED NOISE DURING SECOND HALF OF A GLOTTAL PERIOD
375   IF (MPULSE.LE.0) NOISE=NOISE/2
      MPULSE=MPULSE-1
C     LOW PASS NOISE AT -6 DB/OCTAVE TO SIMULATE
C     SOURCE IMPEDANCE
C     HIGH PASS NOISE AT +6 DB/OCTAVE FOR RADIATION CHARACTERISTICS
C           (TWO EFFECTS CANCEL ONE ANOTHER)
C     GLOTTAL SOURCE VOLUME VELOCITY=VOICING+ASPIRATION
      AASPIR=AASPIR+DAHH
      UASP=AASPIR*NOISE
380   UGLOT=UGLOT+UASP
C     SET FRICTION SOURCE VOLUME VELOCITY
390   AFRIC=AFRIC+DAFF
C     PREPARE TO ADD IN A STEP EXITATION OF VOCAL TRACT
C     IF PLOSIVE RELEASE(I.E IF PLSTEP.GT.0)
      IF (PLSTEP.LE.0) GO TO 391
      STEP=+ PLSTEP
      PLSTEP=0.
391   UFRIC=AFRIC*NOISE
C
C     SELOND GLOTTAL SOURCE THRU CASCADE VOCAL TRACT RESONATORS
C     DO FORMAT EQUATION FOR NNFXC FORMANTS IN DECENDING
C     ORDER TO MINIMIZE TRANSIENTS
      IF (NXSW.EQ.1) GO TO 430
C     BY PASS R6 IF NNXFC LESS THEN 6
      Y6C=UGLOT
```

```
      IF(NNXFC.LT.6) GO TO 415
      Y6C=A6*UGLOT+B6*YL61C+C6*YL62C
      YL62C=YL61C
      YL61C=Y6C
C     BY PASS RS IF NUFXC LESS THAN 5
415   Y5C=Y6C
      IF (NNXFC.LT.5) GO TO 416
      Y5C=A5*Y6C+B5*YL51C+C5*YL52C
      YL52C=YL51C
      YL51C=Y5C
416   Y4C=A4*Y5C+B4*YL41C+C4*YL42C
      YL42C=YL41C
      YL41C=Y4C
      Y3C=A3*Y4C+B3*YL31C+C3*YL32C
      YL32C=YL31C
      YL31C=Y3C
      Y2C=A2*Y3C+B2*YL21C+C2*YL22C
      YL22C=YL21C
      YL21C=Y2C
      Y1C=A1*Y2C+B1*YL11C+C1*YL12C
      YL12C=YL11C
      YL11C=Y1C
C     NASAL ZERO PAIR RNZ:
420   YZC=ANZ*Y1C+BNZ*YLNZ1C+CNZ*YLNZ2C
      YLNZ2C=YLNZ1C
      YLNZ1C=Y1C
C     NASAL RESONATOR RNP :
      YPC=ANP*YZC+BNP*YLNP1C+CNP*YLNP2C
      YLNP2C=YLNP1C
      YLNP1C=YPC
      ULIPSV=YPC
C     ZERO OUT VOICING INPUT TO PARALLEL BRANCH
C     IF CASCADE BRANCH HAS BEEN USED
425   UGLOT=0.
      UGLOTL=0.
C     SEND VOICING AND FRICTION NOISE THRU PARALLEL RESONATORS
C     INCREMENT RESONATORS AMPLITUEDS GRADUALLY
430   CONTINUE
C     FIRST PARALLEL FORMAT R1'(EXCITED BY VOICING ONLY)
      Y1P=A1*A1PAR*UGLOT+B1*YL11P+C1*YL12P
      YL12P=YL11P
      YL11P=Y1P
C     NASAL POLE RN '(EXCITED BY FIRST DIFF OF VOICING SOURCE)
      UGLOT1=UGLOT-UGLOTL
      UGLOTL=UGLOT
      YN=ANP*A1PAR*UGLOT1+BNP*YLNP1+CNP*YLNP2
      YLNP2=YLNP1
      YLNP1=YN
C     EXCITE FORMATS R2'-R4' WITH FRICTION NOISE PLUSE
C     FIRST DIFF  VOICING
      Y2P=A2*A2PAR*(UFRIC+UGLOT1)+B2*YL21P+C2*YL22P
      YL22P=YL21P
      YL21P=Y2P
      Y3P=A3*A3PAR*(UFRIC+UGLOT1)+B3*YL31P+C3*YL32P
      YL32P=YL31P
      YL31P=Y3P
      Y4P=A4*A4PAR*(UFRIC+UGLOT1)+B4*YL41P+C4*YL42P
      YL42P=YL41P
      YL41P=Y4P
C     EXCITE FORMAT RESONATOR RS'-R6' WITH FRIC NOISE
      Y5P=A5*A5PAR*UFRIC+B5*YL51P+C5*YL52P
      YL52P=YL51P
      YL51P=Y5P
      Y6P=A6*A6PAR*UFRIC+B6*YL61P+C6*YL62P
      YL62P=YL61P
      YL61P=Y6P
C     ADD  UP OUTPUT FROM RN,R1-R6 AND BY PASS PATH .
      ULIPSF=Y1P-Y2P+Y3P-Y4P+Y5P-Y6P+YN-ANPAR*UFRIC
440   CONTINUE
      ULIPS = (ULIPSV+ULIPSF+STEP)*(170.)
C     ADD CASCADE AND PARALLEL VOCAL TRACT OUT PUTS
C     (SCAL BY 170 TO LEFT JUSTIFY IN 16-BIT WORD)
      STEP=.995*STEP
C     FIND CUMALATIV ABSOL MAX OF WAVE FORM SINCE BEGINING OF UTT
500   IF(ULIPS.GT.OUTMA) OUTMA=ULIPS
      IF(-ULIPS.GT.OUTMA) OUTMA=-ULIPS
C     TRUNCATE WAVE FORM SAMPLES TO ABS (WAVMA)
      IF(ULIPS.LE.FLOAT(WAVMA)) GO TO 510
      ULIPS=FLOAT(WAVMA)
510   IF(ULIPS.GE.FLOAT(WAVMAX)) GO TO 520
      ULIPS=FLOAT(WAVMAX)
520   IWAVE(NTIME)=IFIX(ULIPS)
530   CONTINUE
540   RETURN
      END
C     SET ABC.FOR
C     CONVERT FORMANT FREQUENCY
```

```
      INTEGER F,FB
      COMMON/PIXX/PIT,TWOPIT
C     REPLACE BY R=EXPTAB(FB) FOR FASTER EXECUTION
      R=EXP(-PIT*FLOAT(FB))
      C=-R*R
C     REPLACE BY=COSTAB(F) FOR FASTER EXECUTION
      B=2.*R*COS(TWOPIT*FLOAT(F))
      A=1.-B-C
620   CONTINUE
C     IF F IS MINUS COMPUT A,A,C FOR A ZERO PAIR
      IF(F.GE.0)RETURN
      IF(A.EQ.0)A=1
630   A=1./A
      B=-A*B
      C=-A*C
      RETURN
      END
C     GETAMP.FOR  SUAD
CC    CONVERT DB ATTENUATION (FROM 96 TO -72) TO A LINEAR SCAL FACTOR
C     (TRUNCATE IF OUTSIDE RANGE)
      FUNCTION GETAMP(NDB)
C
      DIMENSION DTABLE(11),STABLE(28)
      DATA DTABLE/1.8,1.6,1.43,1.26,1.12
     1,1.0,0.89,0.792,0.702,0.623,0.555/
      DATA STABLE/65536.,32768.,16384.,8192.,4096.,2048.,1024.,512.,
     1256.,128.,64.,32.,16.,8.,4.,2.,1.,.5,.25,.125,.0625,.0312,.0156,
     1.0078,.0039,.00195,.000975,.000487/
C
650   NDB1=NDB
      GETAMP=0.
      IF(NDB1.LE.-72) RETURN
      IF(NDB1.GT.96) NDB1=96
      NDB2= NDB1/6
      NDB3=NDB1-(6*NDB2)
      XX1=STABLE(17-NDB2)
      XX2=DTABLE(6-NDB3)
      GETAMP=XX1*XX2
660   CONTINUE
C     END OF ALL THE SUBROUTINE USED IN THISE PROG  DATED 26 APRIL
C
      RETURN
      END
```

App-J

```
      AV   2     0
      A3   0     0
      B4   0   250
      AF   0     0
      A4   0     0
      F5   0  4500
      AH   0     0
      A6   0     0
      B5   0   200
      AVS  0     0
      A6   0     0
      F6   0  4900
      F0   2     0
      Ab   0     0
      B6   0  1000
      F1   2   450
      B1   1    50
      FNP  0   250
      F2   214500
      B2   1    70
      BNP  0   100
      F3   2  2450
      B3   1   110
      BNZ  0   100
      F4   2  3300
      SW   0     0
      BGS  0     0
      FNZ  0   250
      FGP  0     0
      SR   010000
      AN   0     0
      BGP  0   100
      NWS  0   100
      A1   0     0
      FGZ  0  1500
      GO   0    47
      A2   0     0
      BGZ  0  6000
      NFC  0     4
 10
    AV    F0    F1    F2    F3    F4
    18   115   802  1220  2202     0
  18   115  800  1200  2200  0  0
  18   115  800  1200  2200  0  0
  18   150  800  1200  2200  0  0
 18    150  800  1200  2200  0  0
 18    200  800  1200  2200  0  0
18  200   800  1200  2200  0  0
18  250    800  1200  2200  0  0
18  250   800   1200   2200  0  0
```

APPENDIX-I

List of control parameters for the software formant synthesizer. The second column indicates whether the parameter is normally constant (C) or variable (V) during the synthesis of English sentences. Also listed are the permitted range of values for each parameter, and a typical constant value.

N	V/C	Sym	Name	Min	Max	Typ
1	V	AV	Amplitude of voicing (dB)	0	80	0
2	V	AF	Amplitude of frication (dB)	0	80	0
3	V	AH	Amplitude of aspiration (dB)	0	80	0
4	V	AVS	Amplitude of sinusoidal voicing (dB)	0	80	0
5	V	F0	Fundamental freq. of voicing (Hz)	0	500	0
6	V	F1	First formant frequency (Hz)	150	900	450
7	V	F2	Second formant frequency (Hz)	500	2500	1450
8	V	F3	Third formant frequency (Hz)	1300	3500	2450
9	V	F4	Fourth formant frequency (Hz)	2500	4500	3300
10	V	FNZ	Nasal zero frequency (Hz)	200	700	250
11	C	AN	Nasal formant amplitude (dB)	0	80	0
12	C	A1	First formant amplitude (dB)	0	80	0
13	V	A2	Second formant amplitude (dB)	0	80	0
14	V	A3	Third formant amplitude (dB)	0	80	0
15	V	A4	Fourth formant amplitude (dB)	0	80	0
16	V	A5	Fifth formant amplitude (dB)	0	80	0
17	V	A6	Sixth formant amplitude (dB)	0	80	0
18	V	AB	Bypass path amplitude (dB)	0	80	0
19	V	B1	First formant bandwidth (Hz)	40	500	60
20	V	B2	Second formant bandwidth (Hz)	40	500	70
21	V	B3	Third formant bandwidth (Hz)	40	500	110
22	C	SW	Cascade/parallel switch	0(CASC)	1(PARA)	0
23	C	FGP	Glottal resonator 1 frequency (Hz)	0	600	0
24	C	BGP	Glottal resonator 1 bandwidth (Hz)	100	2000	100
25	C	FGZ	Glottal zero frequency (Hz)	0	5000	1500
26	C	BGZ	Glottal zero bandwidth (Hz)	100	9000	6000
27	C	B4	Fourth formant bandwidth (Hz)	100	500	250
28	V	F5	Fifth formant frequency (Hz)	3500	4900	3750
29	C	B5	Fifth formant bandwidth (Hz)	150	700	200
30	C	F6	Sixth formant frequency (Hz)	4000	4999	4900
31	C	B6	Sixth formant bandwidth (Hz)	200	2000	1000
32	C	FNP	Nasal pole frequency (Hz)	200	500	250
33	C	BNP	Nasal pole bandwidth (Hz)	50	500	100
34	C	BNZ	Nasal zero bandwidth (Hz)	50	500	100
35	C	BGS	Glottal resonator 2 bandwidth	100	1000	200
36	C	SR	Sampling rate	5000	20 000	10 000
37	C	NWS	Number of waveform samples per chunk	1	200	50
38	C	G0	Overall gain control (dB)	0	60	47
39	C	NFC	Number of cascaded formants	4	6	5